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Washington Univ, St Louis, Mo

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The study of automotive vehicle pollution in a metropolitan area requires accurate reporting of emissions. This depends on efficient monitoring of traffic flow, and knowing the location parameters critical to the emission process, and adequate knowledge of vehicular emissions under a range of operating conditions. This report describes the methodology developed to allow the estimation of emissions from line and area sources for any specified hour of the day and any specified day of the week. It utilized a local study by the Federal Highway Administration which characterizes vehicle operation in the St. Louis regional highway network. This is combined with the EPA's model emission calculational procedure to compute emissions.

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by

Lonnie E. Haefner

Washington University
St. Louis, Missouri

Contract No. 68-02-2060

EPA Project Officer: Charles C. Masser

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CHAPTER I

INTRODUCTION - STUDY DESIGN

A. INTRODUCTION - OBJECTIVES OF RESEARCH

The continuing development of constructive basic research activities related to estimation of mobile source emissions dictates that use be made of the latest information on speed and acceleration mode properties, and their relation to emissions. These properties should be formatted in conjunction with recently developed capabilities to efficiently define and synthesize a set of line sources for a study region.

The objective of this research is to combine information and techniques on the above referenced speed modes and line source definitions to yield a methodology for estimating line source and non-line or area source emissions for a particular study region. Several specific performance objectives are attained in the research endeavors. They are

a.) The devising of a methodology for estimation of CO, HC, NO_x, particulate, and SO_2 emissions for each of the line source links identified in EPA Contract No. 68-02-1417, and documented in Methodology for the Determination of Emission Line Sources in the RAPS Program. The methodology developed allows the estimation of emissions from line sources for any specified hour of the day and any specified day of the week. It utilizes the following data sources to characterize vehicle operation in the St. Louis regional highway network in conjunction with the EPA modal emissions procedure:

i) Federal Highway Administration (DOT) Vehicle Operating Survey.

ii) Transportation Systems Center (DOT) Traffic Analyser Survey.

iii) General Motors Proving Grounds CHASE Car Program.

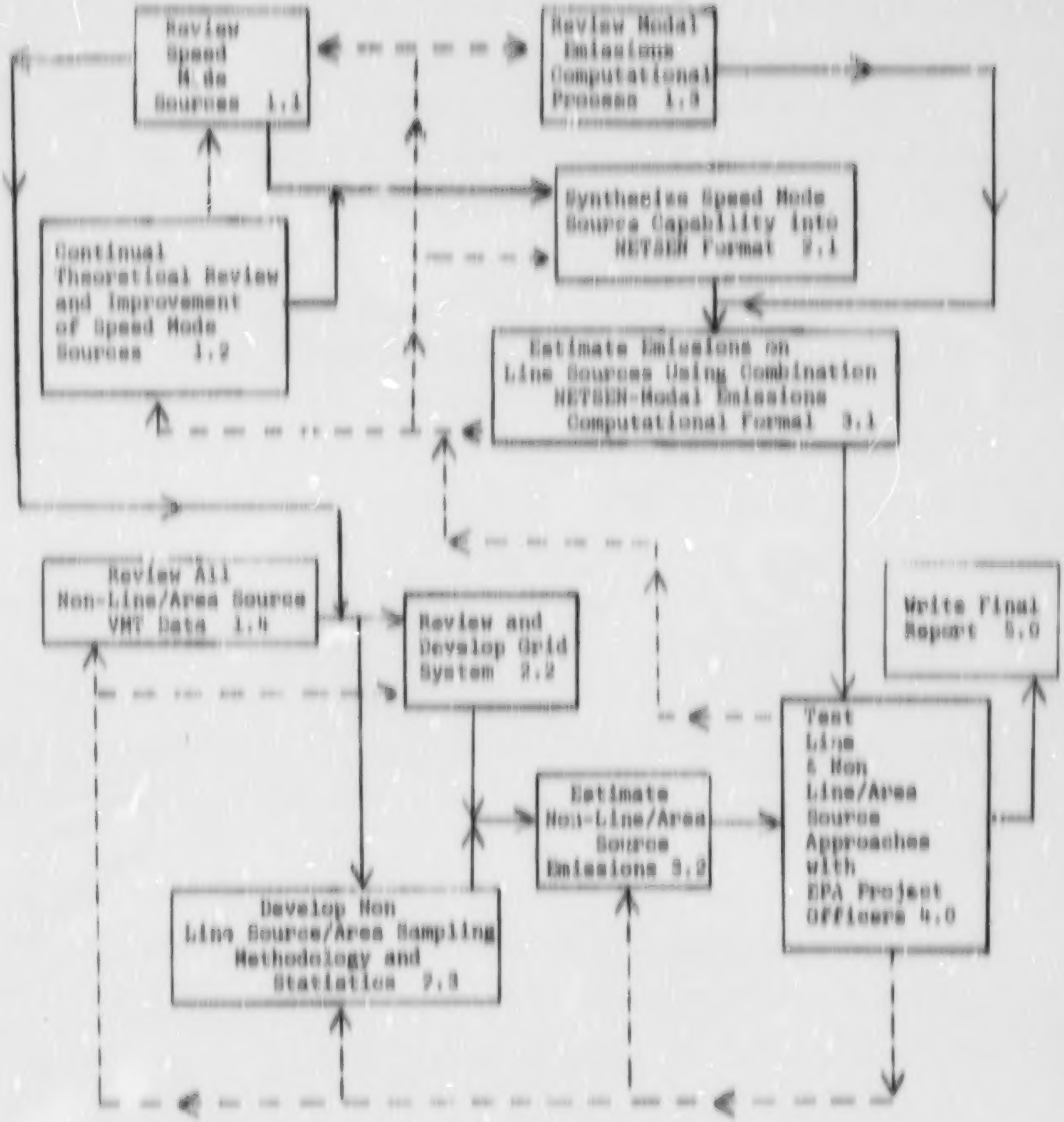
b.) The devising of a methodology to estimate emissions by grid for the St. Louis AQCR for all non-line source links identified under EPA Contract No. 68-02-1417. This technique employs the same vehicle operating data listed in (A) above, and enables CO, HC, NO_x, particulate, and SO emissions to be estimated from non-line sources for the AQCR grids supplied by the EPA project officer. These estimates are capable of being performed for any specified hour of the day and any specified day of the week, including the ability to account for cold start phenomena.

c.) The methods and techniques devised are tested for a number of time-of-day/day-of-week combinations. These tests are documented in this report in order to familiarize appropriate EPA personnel with the methodologies' operation and capabilities.

The previous contract effort, EPA Contract 68-02-1417, developed a limited literature search into traffic behavior and air pollution emissions, and the reader is referred to the project final report for coverage of the relationship of CO, HC and NO_x with speed and associated traffic operations and roadway geometric design variables.[1]

5. FORMAL RESEARCH WORK PLAN

To accomplish the stated objectives, a five phase work plan has been pursued, as shown in Figure 1.


Review Speed Mode Sources 1.1
Review Modal Emissions Computational Process 1.3
Synthesize Speed Mode Source Capability into NETSEN Format 2.1
Continual Theoretical Review and Improvement of Speed Mode Sources 1.2
Estimate Emissions on Line Sources Using Combination NETSEN-Modal Emissions Computational Format 3.1
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Test Line & Non Line/Area Source Approaches with EPA Project Officers 4.0
Estimate Non-Line/Area Source Emissions 3.2
Develop Non Line Source/Area Sampling Methodology and Statistics 2.3

Figure 1

RESEARCH WORK PLAN

Phase 1 has four component tasks within it, to initiate the project in a balanced and effective manner. Task 1.1 reviewed all field data and empirical literature sources on speed modes, by functional classification. It is apparent that the sources of field data on speed modes are the FHWA, DOT Transportation Systems Center and GM CHASE car programs performed at East-West Gateway. Appropriate contact with East-West Gateway Staff personnel, EPA personnel and the above study groups was made to assemble, study and interpret their findings on speed modes. Overlapping very closely with this phase, particularly with respect to published literature, was Task 1.2. This task, performed continuously throughout the duration of the project, attempted, through study of theoretical and empirical traffic flow and emissions literature, to improve insights into accuracy of speed modes with respect to functional classification and traffic and design attributes relevant to the line source network. Where speed modes are currently unresearched for portions of functional class and design types, this task attempted to synthetically describe such mode patterns, through consistent interpretation of the theoretical literature, as illustrated later in Chapter III. The task made use of appropriate literature related to speed and delay studies, shockwave phenomena, acceleration noise, and queuing theory.

Task 1.3 entailed a review of the EPA Modal Emissions Estimation Process, reviewing the use of speed mode characteristics in estimating emissions, and readying the computational process for integration into the rest of the research procedure.[2]

Task 1.4 reviewed the data set for non-line/area sources in the St. Louis AQCR. All non-line/area sources were reviewed with respect to the presence of adequate VMT information, and appropriate classification and generic description. Appropriate data collection with respect to regional origin-destination information, and zonal trip generation data was undertaken, in order to implement the methodologies utilized in Chapter IV.

Phase 2 was also composed of several tasks. Task 2.1 altered the format of the HETSEN process developed by the research team in EPA Contract No. 68-02-1417, to allow the HETSEN computation to accept an appropriate functionally classified speed mode as the intervening link descriptor used in computing emissions.

Task 2.2 developed the grid system for use in computing non-line/area source emissions. The map of grids for the St. Louis AQCR supplied by the project officer was reviewed, in light of the topology of the St. Louis regional network, its functional classification, and availability of data as discussed in Task 1.5. The objective of this review was to ready the non-line/area sources of emission for methodological treatment in Task 2.3, and ultimate computation of emissions in Phase 3.

Task 2.3 employs a trip generation approach to estimate non-line/area source emissions. East-West Gateway transportation zone trip productions were assigned to a sample of the corresponding EPA grid squares. Further analysis established the vehicle trips per this sample of grid squares, which when multiplied by the mean trip length, and subjected to statistical analysis determined the non-line (local and collector) VMT over the entire study region, on a grid-by-grid basis. Appropriate emission factors were then applied to each grid VMT to develop area source emissions, as per Task 3.2.[3]

Phase 3 is the actual estimation of emissions for line sources and grids, employing all information previously discussed. In Task 3.1, the line source technique merges the NETSEN line source definition capabilities with the emissions estimation properties of the Modal Emissions Computational Format, using speed mode as the key interfacing line source attribute. Task 3.2 estimates non-line/area sources of local and collector streets aggregated into grids, using the trip generation analysis in conjunction with the emission factors, as discussed above. In both line and non-line/area source emission estimates, the results for 24 hour periods are arrayed for CO, HC, NO_x, particulates, and SO_2.

Phase 4 tests the line and non-line/area source techniques for a number of time-of-day/day-of-week combinations of operating characteristics, as illustrated in Chapters III and IV. The primary system attributes varied in these tests are hourly volumes, $\frac{V}{C}$ ratios and 24 hour average daily traffic volumes. Distributions collected for daily traffic variation throughout the week, and hourly variations through the day were used to input appropriate VMT information for specified day and hour combinations. This information is available from work on EPA Contract No. 68-02-1417, and was modified slightly from information developed from Task 1.4. As referenced in Figure 1, and the above text, appropriate feed-back, review and recomputation of entities and findings in Tasks 1.1, 1.2, 1.3, 1.4, 2.1, 2.2, 2.3, 3.1, and 3.2 was made to insure that such interpretations and conclusions are as sound as possible.

Phase 5 combines the above data sources, computational formats, emissions estimates and time-sensitive tests, interpretations and conclusions into a final written report contained herein. The following text will elaborate on data sources, line and area source computational techniques, example output, and related sensitivity analyses. In addition, appendices will be provided on software documentation and data formats.

Footnotes Chapter 1

[1] Pages 2-12, Environmental Protection Agency Contract No. 68-02-1417, *Methodology for the Determination of Emission Line Sources*, Dr. Lonnie E. Haefner, Principal Investigator, February 28, 1975.

[2] Environmental Protection Agency Contract No. 68-02-0435, *Automobile Exhaust Emission Modal Analysis Model*, Calspan Corporation, January 1974.

[3] *Supplement No. 5 for Compilation of Air Pollutant Emission Factors*, Second Edition, U.S. Environmental Protection Agency, December, 1975.

CHAPTER II

DATA DEVELOPMENT

A.) DESCRIPTION OF STUDY AREA

An assessment of roadways with respect to emissions requires that the roadway network under study be classified according to a set of parameters that allows appropriate hierarchial analysis. Selection of these parameters is of prime importance, since some links of the roadway network will be much more critical from an emissions standpoint than others.

The data collection effort focused on 12 counties in the St. Louis Air Quality Control Region (AQCR), as shown in Figure 2. The areas within the St. Louis AQCR include St. Louis City, St. Louis County, St. Charles County, Jefferson County, and Franklin County for Missouri, and Bond County, Clinton County, Madison County, Monroe County, Randolph County, St. Clair County and Washington County for Illinois.

Roadway data was collected within the St. Louis AQCR in light of emissions and sensitivity to highway functional class, volume, and composition of vehicles present, and the operational characteristics of vehicles related to both traffic volume and average speed alterations due to roadway alignment and profile. Other data collected includes the intensity and type of adjacent land use, and certain highway design characteristics which affect the localized air quality.

A number of agencies were contacted to compile the St. Louis roadway inventory. They include the East-West Gateway Coordinating Council, Missouri State Highway Department-Jefferson City and St. Louis District VI Offices, the Region VII Office of the Illinois Department of Transportation, the Office of the Deputy Commissioner of the City of St. Louis Street Department, St. Louis County Division of Highways and Traffic, and the counties of St. Charles, Jefferson, and Franklin.[1]

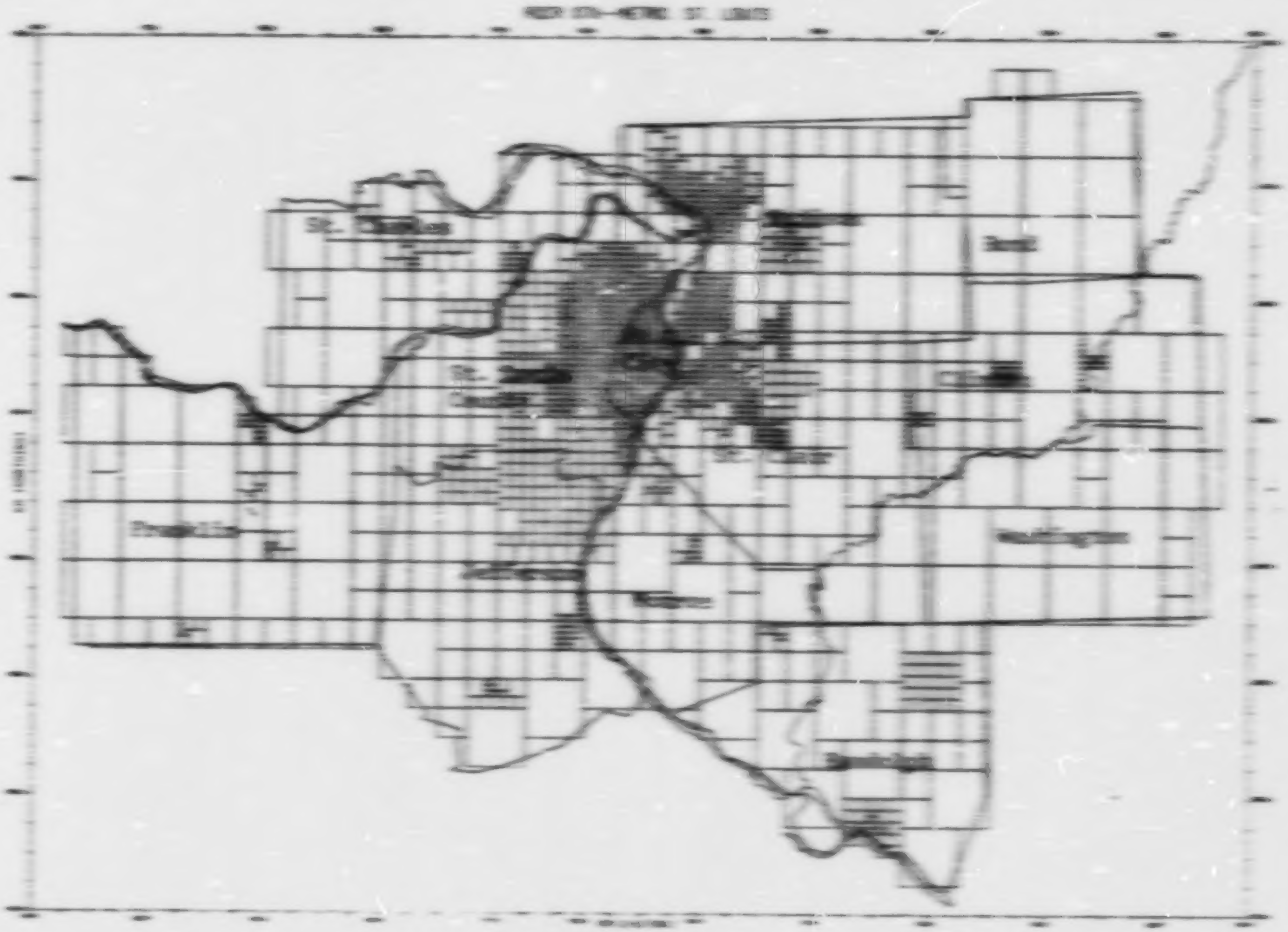
St. Charles
Madison
Bond
St. Louis County
Clinton
St. Clair
Franklin
Jefferson
Monroe
Washington
Randolph

FIGURE 2 St. Louis AQCR

B.) LINE SOURCE DATA

A working set of highway segments of freeway, principal arterial, and minor arterial roadways was established through the use of United States Geological Survey topographic maps for the entire St. Louis AQCR. Actual street names and route numbers for all roadway segments were recorded from maps provided by the Auto Club of Missouri. A grid system for the AQCR was provided by the Environmental Protection Agency. Roadway links were broken up such that no links would cross an EPA grid boundary, thus identifying each link as existing within a particular grid.

The initial data collection effort for the three major classes of roadway (i.e. freeway, principal arterial, and minor arterial) concerned traffic volumes. Traffic volume information sought for each link consisted of average daily traffic (ADT), peak hour traffic, hourly distribution of traffic, percent of heavy duty vehicles, and the peak directional distribution of traffic. All the above were obtained for the Missouri counties of St. Louis, St. Louis City, and St. Charles. In Illinois, only average daily traffic was available.

Link attributes sought to describe vehicle operating characteristics were the volume to capacity ratio (V/C), peak hour speed by direction, average daily speed, and capacity alterations such as complex interchanges, lane drops and bottleneck sections. The capacity information obtained from East-West Gateway was a representative daily capacity factored down to obtain a peak hour V/C ratio at level of service E.[2] Current peak hour speed data by direction was available for a majority of the links of the central counties from East-West Gateway. Through the cooperation of the Illinois Department of Transportation and local agencies in St. Louis and

St. Louis County, a complete set of links with capacity alteration consisting of complex interchanges, lane drops, and/or major bottlenecks was compiled. The study team used the same roadway topographical information for freeways as previously developed in EPA Contract 68-02-1417. The four terrain types used were: deep cut, high fill, street canyon, and rolling terrain.

In addition, several major speed data sets relating to Federal DOT research and field study in the region were obtained from the East-West Gateway Coordinating Council. These include the results of the Federal Highway Administration Vehicle Operating Survey, the Transportation Systems Center Traffic Analyser Survey, and the General Motors Proving Grounds CHASE Car Program.[3] The use of the FHWA vehicle operating survey speed data is discussed in detail in Chapter 3. The Transportation Systems Center III Traffic Analyser data was reviewed, and it was determined that no direct use could be made of it in the current research. The General Motors CHASE Car data was also examined, and was not directly incorporated into any of the current data bases.

Land use by type and intensity was another descriptor used for link differantiation. East-West Gateway provided an area map delineating regional land use and major activity centers, including commercial development, residential development, recreational development, hospitals, universities or colleges, airports and multi-family development.

In the case of principal and minor arterials, some additional link attribute information was investigated relating to the progressive movement along a route. Progressive movement is typified by a continuous flow of a platoon of vehicles over long stretches of highway. This platooning of vehicles can be induced by interconnected or pre-timed progressive signal systems and the distribution of a network of one-way streets. The City of St. Louis, St. Louis County, Missouri State Highway Department, and the Illinois Department of Transportation provided complete information on locations of such progressive flow.

The above line source data for this research was compiled on an individual link basis for the St. Louis AQCR. Subsequent to such compilation, the data was keypunched and readied for input into the software system described in Chapter III.

5.2 AREA SOURCE DATA

The non-line/area source data requirements were somewhat different than those described above for line sources. The area source methodology is concerned with the estimation of mobile source emissions on local and collector roadways within each of the EPA grid square areas. The output of this process is an hourly estimate of the amount of each of the types of pollutants (CO, NO_x, HC, SO_2 and particulates) with correction for cold start operations.

One of the primary problems encountered is the relative sparseness of vehicle count data on local and collector roadways. At best, after exhaustive data collection from agencies for the St. Louis AQCR, only limited data is available in the most densely populated areas. Hence, the most significant problem is the estimation of VKT's on local and collector roadways, since corrected emission factor estimation equations are readily available elsewhere.[4] Therefore, to calculate volumes on locals and collectors the study team used a trip generation approach, described in

Chapter IV. Data used in this portion of the study thus consisted of land use information, and transportation study zone maps and the accompanying trip productions per zone. These data items were provided by East-West Gateway.

Footnotes Chapter II

[1] Many of there same agencies were contacted in Environmental Protection Agency Contract No. 68-02-1417, Methodology for the Determination of Emission Line Sources, by Dr. Lonnie E. Haefner. The data collection during Contract No. 68-02-1417 was used as a starting point for data gathered in this research contract.

[2] Level of Service E represents operation of the system with traffic volume at or near capacity. Operating speed is relatively low, flow is unstable and momentary stoppage occurs; the system is on the verge of complete jam and saturation with attendant congestion effects.

[3] DOT-FHWA VEHICLE OPERATING SURVEY for St. Louis; DOT-Transportation Systems Center Traffic Analyser Survey for St. Louis; and General Motors - CHASE Car Study for St. Louis.

[4] $$E_{npstwx} = \sum_{i=n-12}^{n} C_{ipn} M_{in} V_{ips} Z_{ipt} R_{iptwx},$$

where e is the composite emissions factor after various adjustments from Supplement No. 5 for compilation of Air Pollutant Emission Factors, Second Edition, page D3.

CHAPTER III

LINE SOURCE EMISSIONS MODELLING

A.) INTRODUCTION

This chapter is composed of five sections. The first will be a discussion of the Automobile Exhaust Emission Modal Analysis Model, hereafter referred to as the Modal Emissions Model. The discussion will detail the inputs and technique used by the model. The second section describes the NETSEN II network sorting model, which has been updated and expanded from previous work. The third section will deal with the development of speed profile analogies, to allow the use of the Modal Emissions Model for the entire RAPS Study Area of the St. Louis AQCR. The fourth section details the line source emission software system which integrates the computerized network, NETSEN II, and the Modal Emission Model. The last section presents example output from this system to demonstrate its capabilities for line source analysis.

B.) MODAL EMISSIONS MODEL

The Modal Emissions Model was developed by the Calspan Corporation, and has been designed to calculate the amounts of hydrocarbons, carbon monoxide, and oxides of nitrogen emitted by individual automobiles or groups of automobiles stratified by age and geographical location.[1] The emission rates were deduced from surveillance test results performed on a test fleet of 170 automobiles in each of six American cities at varying altitudes. Emissions will be output for any given second by second driving sequence within a speed range of 0 and 60 miles per hour.

The model developers recognized that the emissions response of an automobile depends on the speed profile experienced as its occupants travel

CHAPTER III

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A.) INTRODUCTION

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The model developers recognized that the emissions response of an automobile depends on the speed profile experienced as its occupants travel from their origin to their destination. The developers also recognized that different light duty vehicles have separate emissions responses for the same speed, acceleration, and deceleration profiles. The model does not treat meteorological or transport processes. It specifically details the distribution of emissions along a user defined highway link, and computes the total (CO), (HC), and (NO_x) contributions to the atmosphere from the highway source.

The inputs into the Modal Emissions Model include both traffic and emissions data. The traffic inputs are representative second by second speed profiles on the defined line sources, the number of automobiles assignable to the particular speed profiles on the defined line sources, their age distribution by car model year, and the relative altitude of their operation. The emission parameters include emission rate coefficients that are specific to speed profiles, which are either user supplied or defaulted in the computer program itself. Because of cost and time, unless the user has a vehicle fleet and dynamometer testing equipment, the default emission rate coefficients should be used.

Figure 3 shows a simplified flow diagram for the Modal Emissions Model. Table 1 shows the breakdown by car model age and geographical location of operation. These groupings were developed as part of the automobile surveillance program from which data was used for this computer technique. The most recent car model year is 1971. This is consistent with the time period in which the data for the surveillance study was assembled.

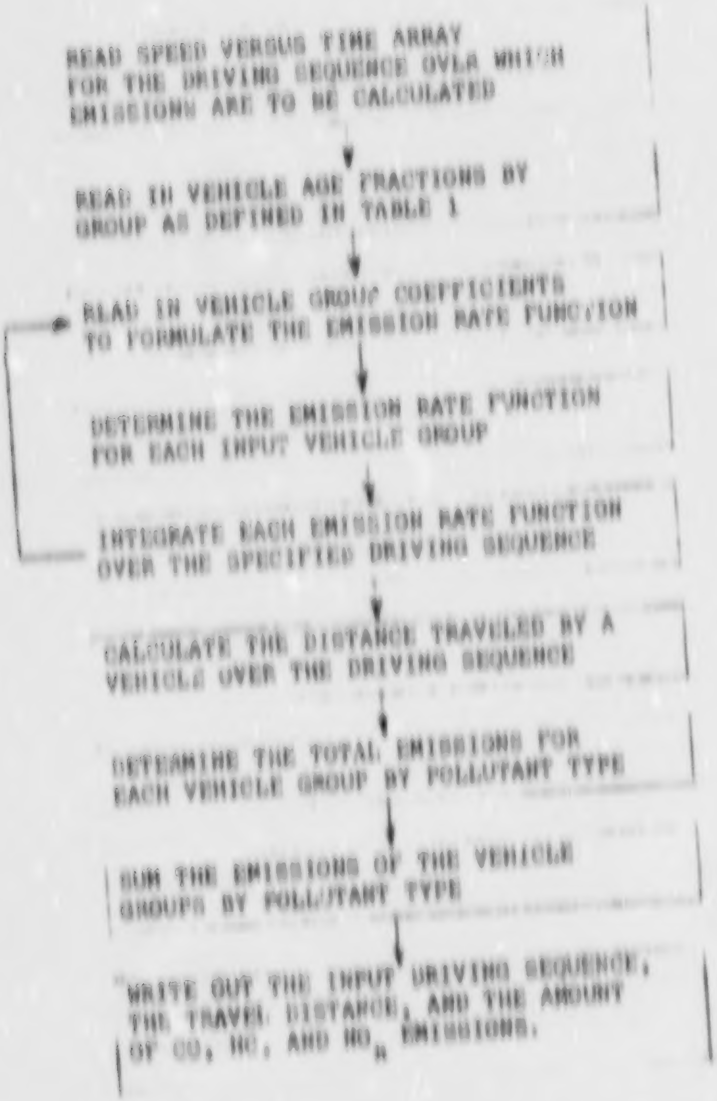

READ SPEED VERSUS TIME ARRAY FOR THE DRIVING SEQUENCE OVER WHICH EMISSIONS ARE TO BE CALCULATED
READ IN VEHICLE AGE FRACTIONS BY GROUP AS DEFINED IN TABLE 1
READ IN VEHICLE GROUP COEFFICIENTS TO FORMULATE THE EMISSION RATE FUNCTION
DETERMINE THE EMISSION RATE FUNCTION FOR EACH INPUT VEHICLE GROUP
INTEGRATE EACH EMISSION RATE FUNCTION OVER THE SPECIFIED DRIVING SEQUENCE
CALCULATE THE DISTANCE TRAVELED BY A VEHICLE OVER THE DRIVING SEQUENCE
DETERMINE THE TOTAL EMISSIONS FOR EACH VEHICLE GROUP BY POLLUTANT TYPE
SUM THE EMISSIONS OF THE VEHICLE GROUPS BY POLLUTANT TYPE
WRITE OUT THE INPUT DRIVING SEQUENCE, THE TRAVEL DISTANCE, AND THE AMOUNT OF CO, HC, AND NO_x EMISSIONS.

FIGURE 3 Automobile Exhaust Emission Modal Analysis Model Operations Flow Chart

Source: "Isolating Stochastic Traffic Flow Phenomena for Air Pollution Emissions Measurement," Thomas K. Ryden, Washington University, 1975

TABLE 1 AUTOMOBILE EXHAUST EMISSION MODAL ANALYSIS MODEL VEHICLE GROUP STRUCTURE DESCRIPTION

Number	Percentage Of Group In The Input Data	Vehicle Group Definition
1	0.09	Pre-1968 Denver autos
2	0.55	Pre-1968 autos operating at low altitudes
3	0.03	1966-1967 California autos
4	0.08	1968 autos operating at low altitudes
5	0.09	1969 autos operating at low altitudes
6	0.08	1970 autos operating at low altitudes
7	0.10	1971 autos operating at low altitudes
8	0.02	1968 Denver autos
9	0.02	1969 Denver autos
10	0.02	1970 Denver autos
11	0.02	1971 Denver autos

Source: "Automobile Exhaust Emission Modal Analysis Model," Report From EPA Contract No. 68-01-0436, 1974.

The emission rate coefficients supplied by the model do not include the effects of a "cold start," which generates a sizable portion of automobile emissions. Further, no deterioration factors are applied, however, they are indirectly incorporated, since the vehicle fleet used in the surveillance program reflected age and state of maintenance effects.

The Modal Emissions Model estimates actual emissions for carbon monoxide and hydrocarbons within 13 percent. The model only predicts nitrogen oxides within 80 percent. The ability of the model to reproduce emissions from additional vehicle fleets was also tested since it was developed from a single vehicle fleet. The model replicated performance to within 30 percent. Although this error appears significant, the input data from the model's own original vehicle fleet could not be replicated any better a second time. Both microscale and mesoscale emission analysis methods have this drawback.

The Modal Emissions Model is capable of operating at a truly microscale level. It allows for highly specific analysis of the emissions consequences of traffic congestion. In so using the model, the user must define the established regional highway network to suit his analysis purposes. This is a major undertaking for a region the size of St. Louis. Further, the second by second speed profile data and localized emission response data on vehicles must be collected, either through actual field efforts, or by development of a systematic scheme of speed profile analogies for line sources, as discussed in section D.

C.) NETSEN II: MODEL DESCRIPTION

This section describes the logic construct of the network sensitivity model, NETSEN II. The model NETSEN II is an update version of NETSEN which was designed in the Environmental Protection Agency study, Methodology for the Determination of Emission Line Sources, Contract No. 68-02-1417. This updated version has additional variables and subroutines discussed herein and in Appendix A.

By way of introduction, a brief reiteration of traffic flow related parameters relevant to the study of emissions is warranted. These parameters include:

Volumes - Average Daily Traffic and peak hour volumes, historically as indicators of use of the facility.

Average Travel Speed - As an indicator of efficiency of the facility and adequacy of design.

General Interzonal Origin-Destination Patterns - As a regional mapping of incidence of travel, and proximity of travel paths to other regional activities.

Functional Classification of Highways - Classed as whether freeway, arterial, collector or local, as an indication of importance and frequency of use and level of design standards employed.

Delay Information - which modifies or refines information on average speed, above, through studies of volume to capacity ratios, travel time profiles, travel time contours, or waiting time or delay contours. Locations are detected in the system where speeds are radically altered due to delay and congestion.

Locations of Design Related Phenomena - such as extremely complicated route or interchange configurations, and areas of cut or fill, or frontage roads with structures, which induce localized alterations in air quality and emissions. the latter when average speed is modified due to the design phenomena.

Unique Areas of Progression - In addition to areas which can be reviewed from speed and delay information as stated above, these are unique in the network, in that some engineering or planning alteration exists to eliminate congestion by specific means with highly predictable results, such as one-way street flows, or progressive signalization, thus allowing atypical consistency in volumes or average speeds, with stable emissions output.

Areas of Critical Land Use Adjacent to or Within the Network - The first type is an area adjacent to the traffic system which is a highly sensitive land use to emissions output and local air quality, or a land use type such as industrial, which supplements and confounds the emissions level and air quality in the vicinity of the corridor. The second type is the downtown or core area, or the areas of high-rise, high-density buildings. The building heights or "street canyons" affect air quality in the vicinity of the grid and corridor sources.

Vehicle Mix - The composition of traffic, in terms of percentage of autos, intermediate size trucks and large size trucks is relevant, due to differing emissions from vehicle type, and the impact of the traffic composition on average speed and traffic flow throughout a link. The composition of vehicles by age also determines the level of emissions from the traffic stream.

Frequency of Monitoring - All links under study will encompass some or many of the above flow related phenomena which have an impact on emissions and/or air quality. The frequency of observing such network components with respect to adequate characterization of emissions information is critical. Typical choices of duration of traffic volume counting periods include 1, 8, 12, 24 hours, weekly, and peak-off peak combinations.

Definition of a Line Source

Line source definition hinges on the capability of analysing the highway network and its traffic and design attributes at varying levels of detail. This definition capability is dependent on the availability of data and the level of spatial refinement sought by the user for inputting into pollution models such as the Modal Emissions Model. Thus, assuming adequate data, the user has a range of capabilities, from developing a very refined set of descriptors that are termed *ultimate line sources*, to a very unrefined set of descriptors termed *gross line sources*.

The following basic definition of a line source was employed in the development of the program HETSEN II:

> "A line source is the smallest segment of inventoried roadway depictable with a given specific set of attributes for the roadway."[2]

Table 2 represents the set of roadway data characteristics used in defining a line source. HETSEN II was designed to allow the user to pick off those links with relevant characteristics at a level of refinement determined by the user.

HETSEN II Model Logic

The flow chart of the master logic for HETSEN II is shown in Figure 4. Appendix A contains a more detailed software discussion of the operation of HETSEN II.

TABLE 2

ROADWAY CHARACTERISTICS

Average Daily Traffic (ADT)
Special Topography, includes:
1) normal
2) deep cut
3) high fill
4) street canyon
5) rolling topography

Capacity Alterations, includes:
1) normal
2) complex interchange
3) lane reductions
4) bottlenecks

Sensitive Land Uses, includes:
1) normal development
2) commercial development
3) industrial development
4) recreational development
5) hospital
6) university or college
7) airport development
8) multi-family development

Activity Centers, include:
1) Central Business District (CBD)
2) Fringe Area
3) Outlying Business District
4) Residential Area
5) Rural Area

Progressive Movement, includes:
1) none
2) pre-timed progressive
3) interconnected signal systems
4) one-way with progression
5) one-way without progression

Channelization
1) none
2) channelization

Functional Classification, includes:
1) Freeway
2) Principal Arterial
3) Minor Arterial
4) Collector
5) Local

Link Distance
Peak Speed Difference
Truck Volumes
Bus Volumes
Volume over capacity ratio (V/C ratio)

The model begins by reading control cards which define the attributes the model is to test for. An exhaustive list of these attributes appear in Table 2. Next, a line source from the roadway inventory link file is input into the model. As illustrated in Figure 4, the model then begins a series of sequential tests of the line source for the attributes previously defined in the control card. If the line source passes all the tests, it is output for further computation of its emissions and another line source is read in. If the line source fails an attribute test, further testing of it ceases and the program goes back and inputs a new line source. When all of the line sources from the roadway inventory link file are tested for, the set of line sources that passed the tests is ready for use in the Modal Emissions Model.

Two specific points are of major importance concerning NETSEN II:

1) The network can be tested at any level of data attributes that is relevant. These levels can be from very gross descriptions (i.e. testing for all freeway links), to a very refined set of descriptors (i.e. testing for links which have a freeway classification with an ADT of 40,000 to 45,000 vehicles per day with rolling topography, etc.).

2) The level of attribute refinement chosen to be tested may vary with the detail of the data available to the user. Further, the level of refinement of the data may also vary with that deemed necessary by the user for the study of emissions. Thus, complete flexibility exists in describing the behavioral aspects of the network related to emissions estimation.

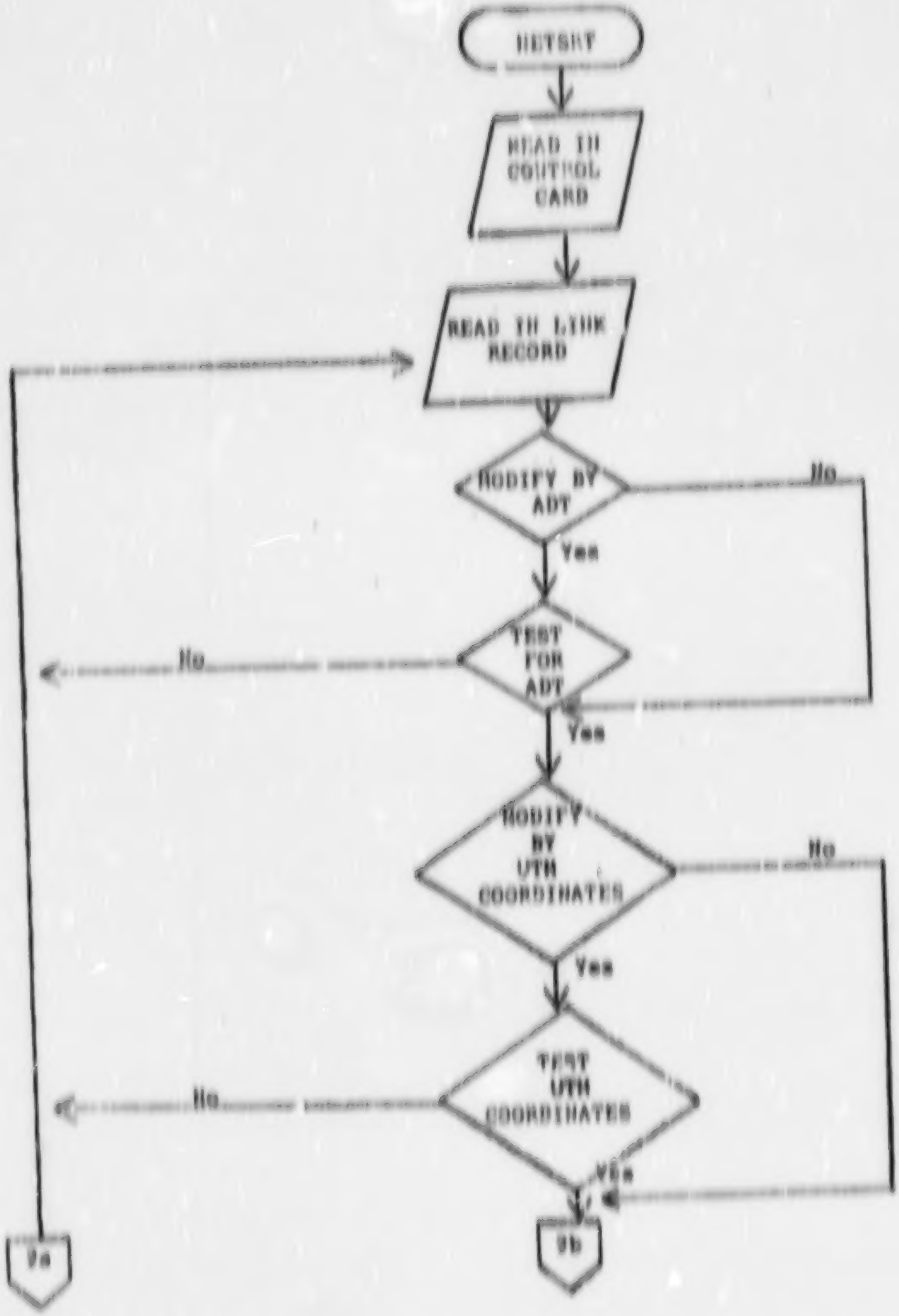
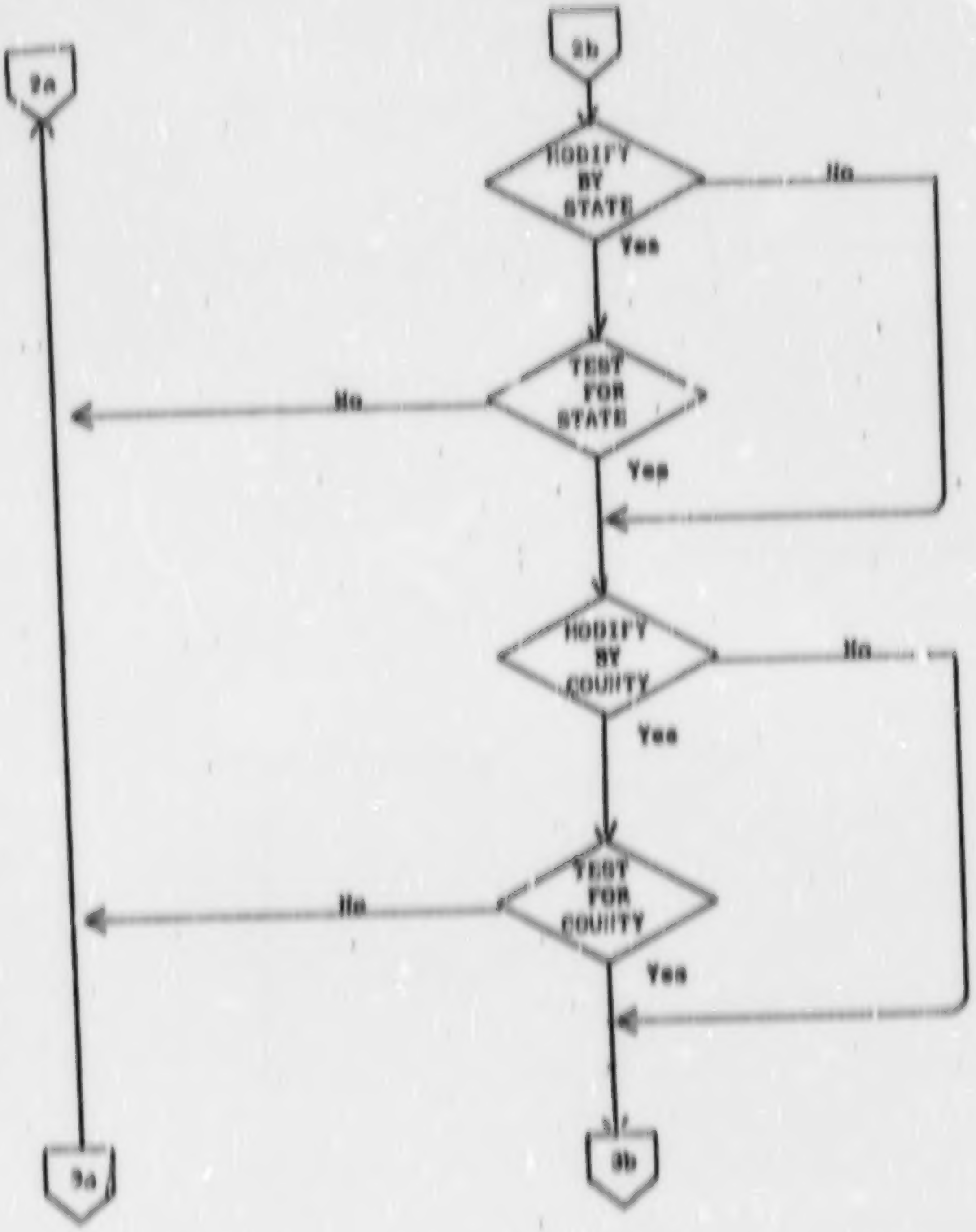
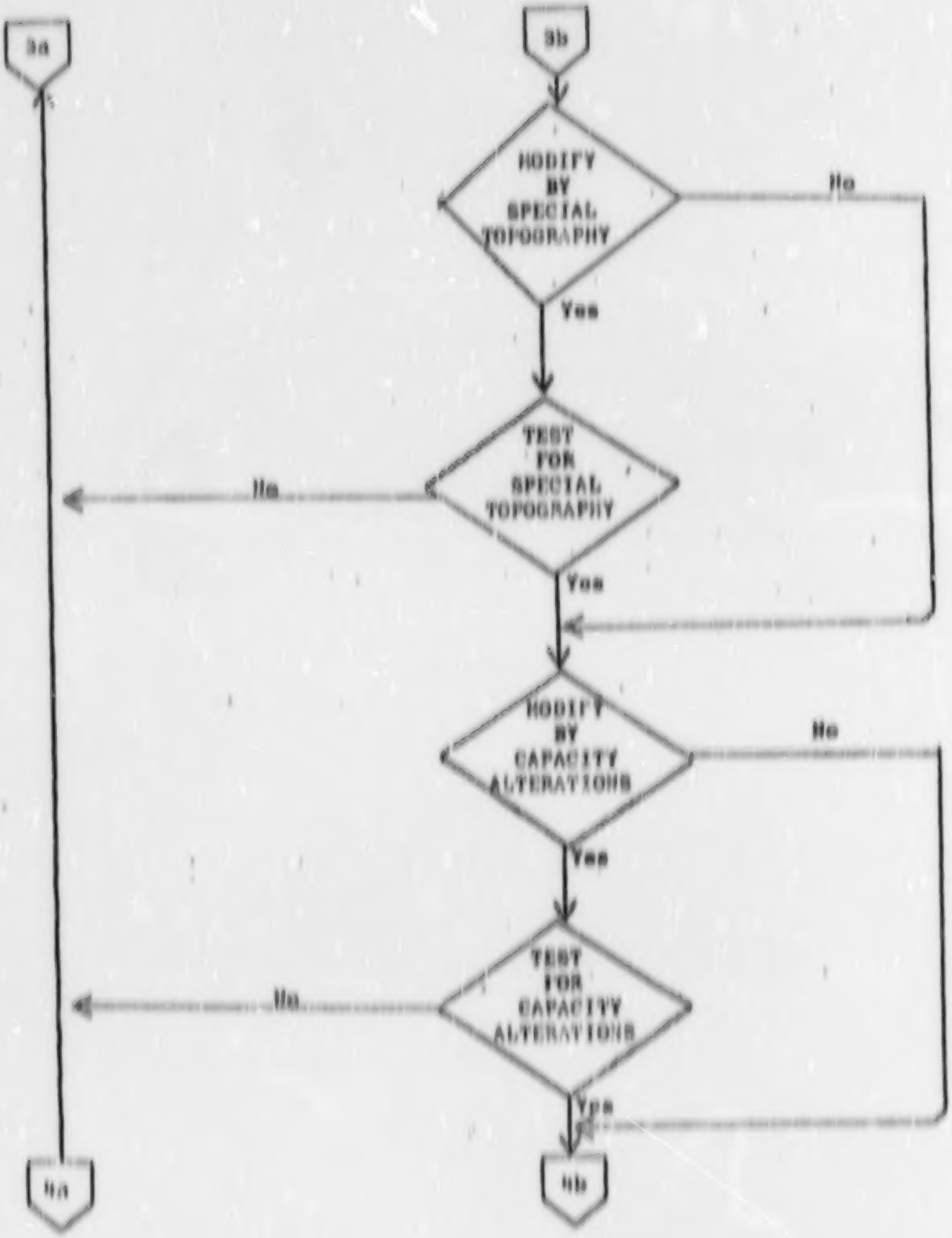
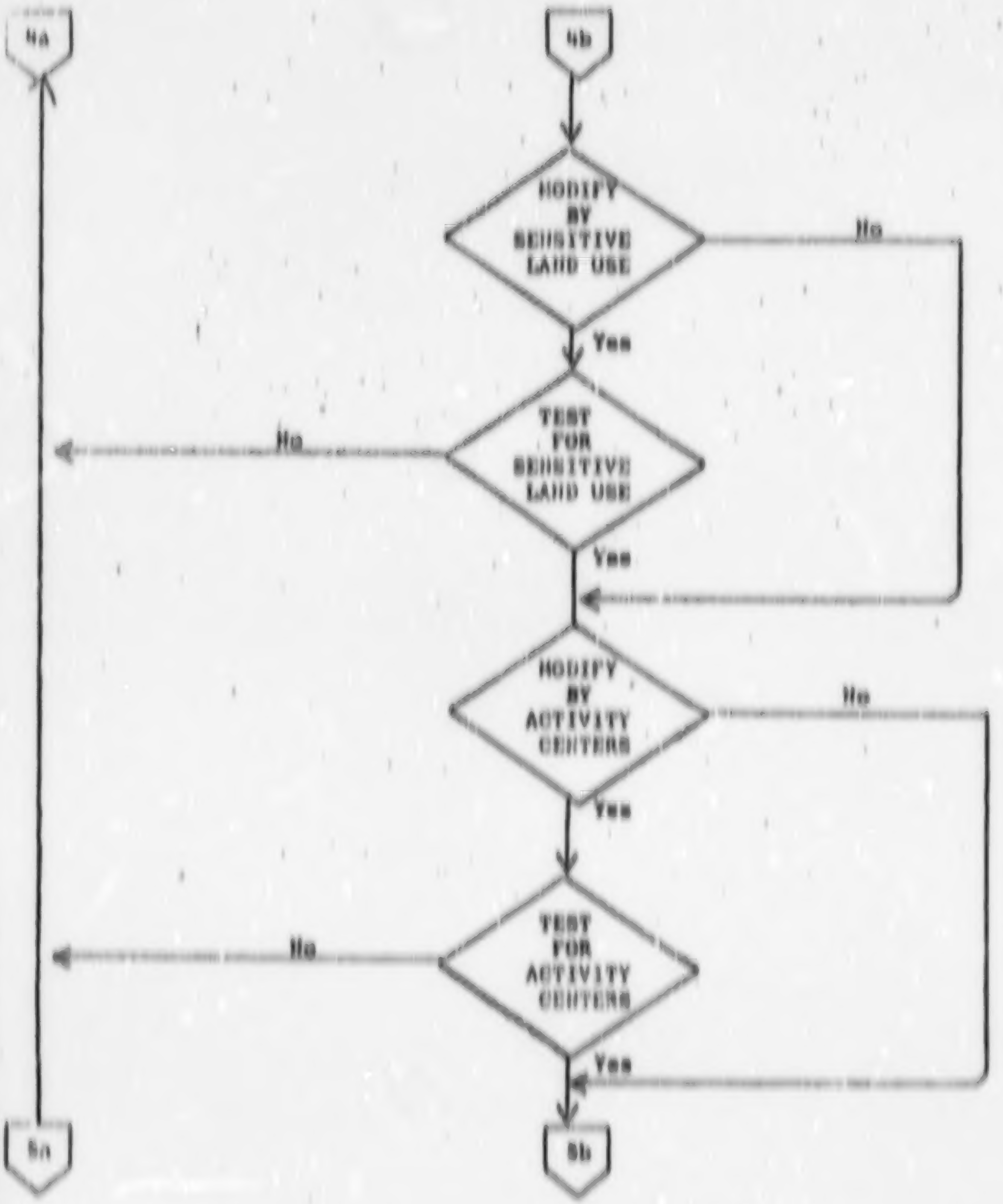

NETSRT
READ IN CONTROL CARD
READ IN LINK RECORD
MODIFY BY ADT
No
Yes
TEST FOR ADT
No
Yes
MODIFY BY UTM COORDINATES
No
Yes
TEST UTM COORDINATES
No
Yes
9a
9b

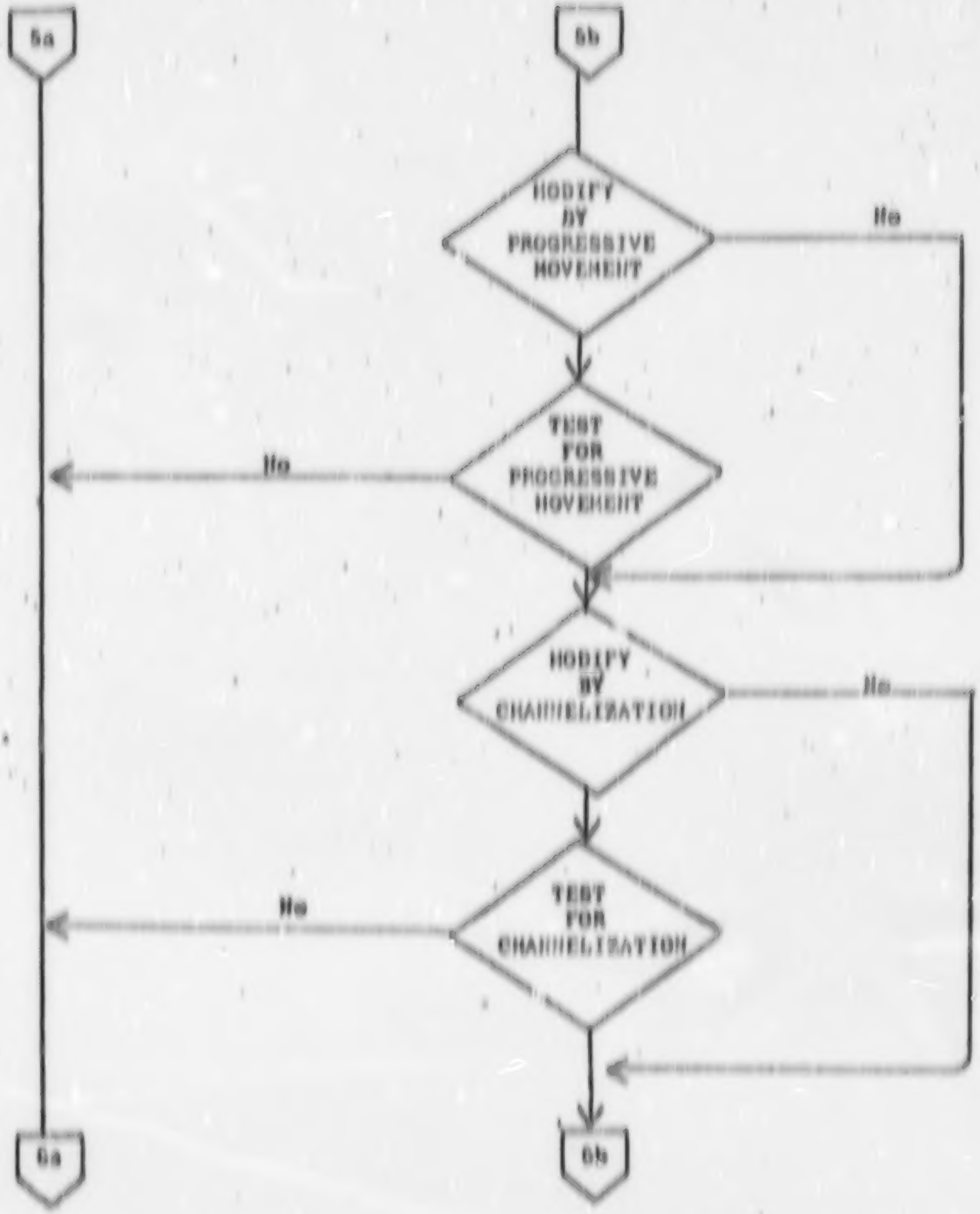
Figure 4

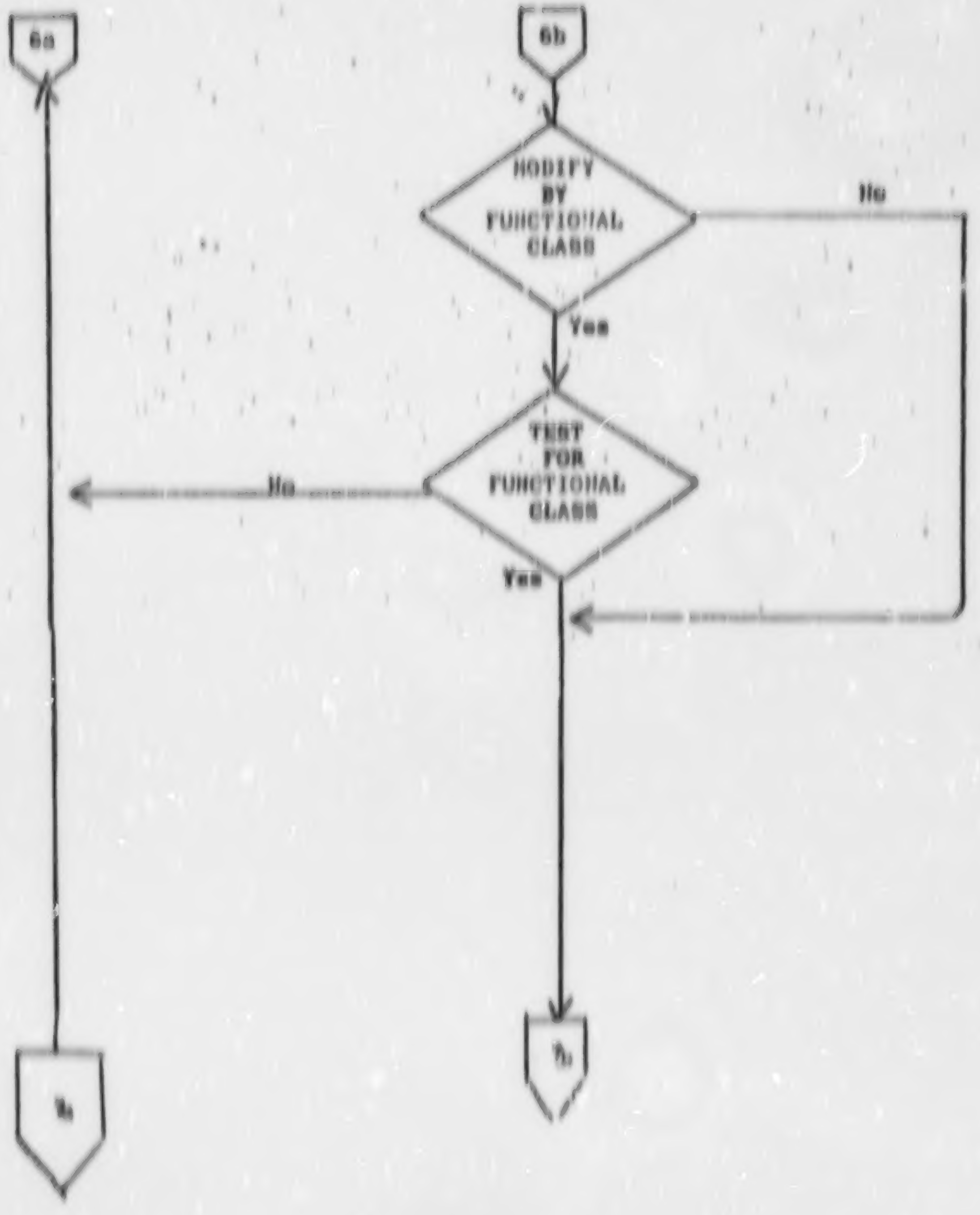
Flowchart Logic of Network Sensitivity Model, NETSEN II

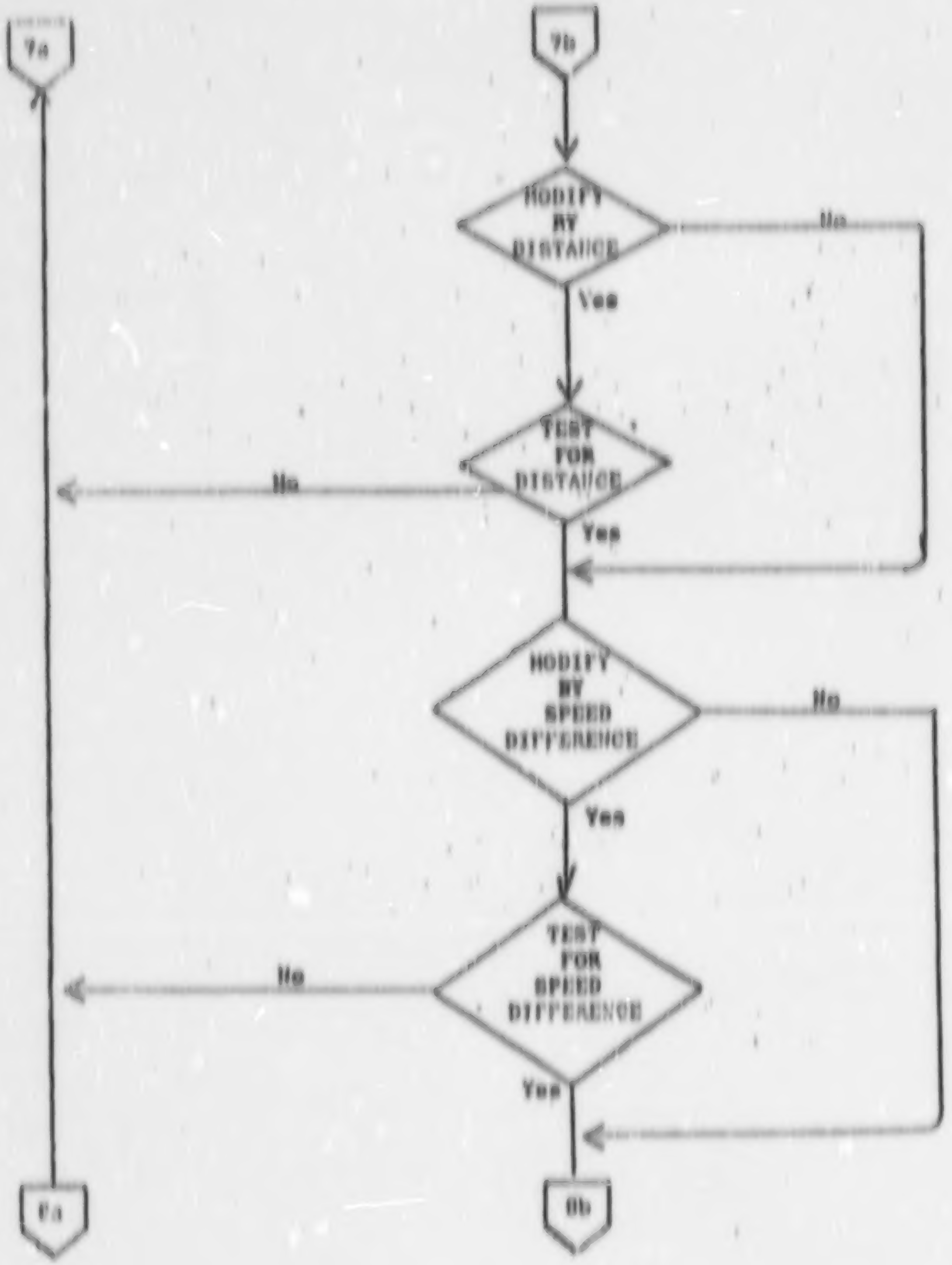

2a
2b
MODIFY BY STATE
No
Yes
TEST FOR STATE
No
Yes
MODIFY BY COUNTY
No
Yes
TEST FOR COUNTY
No
Yes
3a
3b

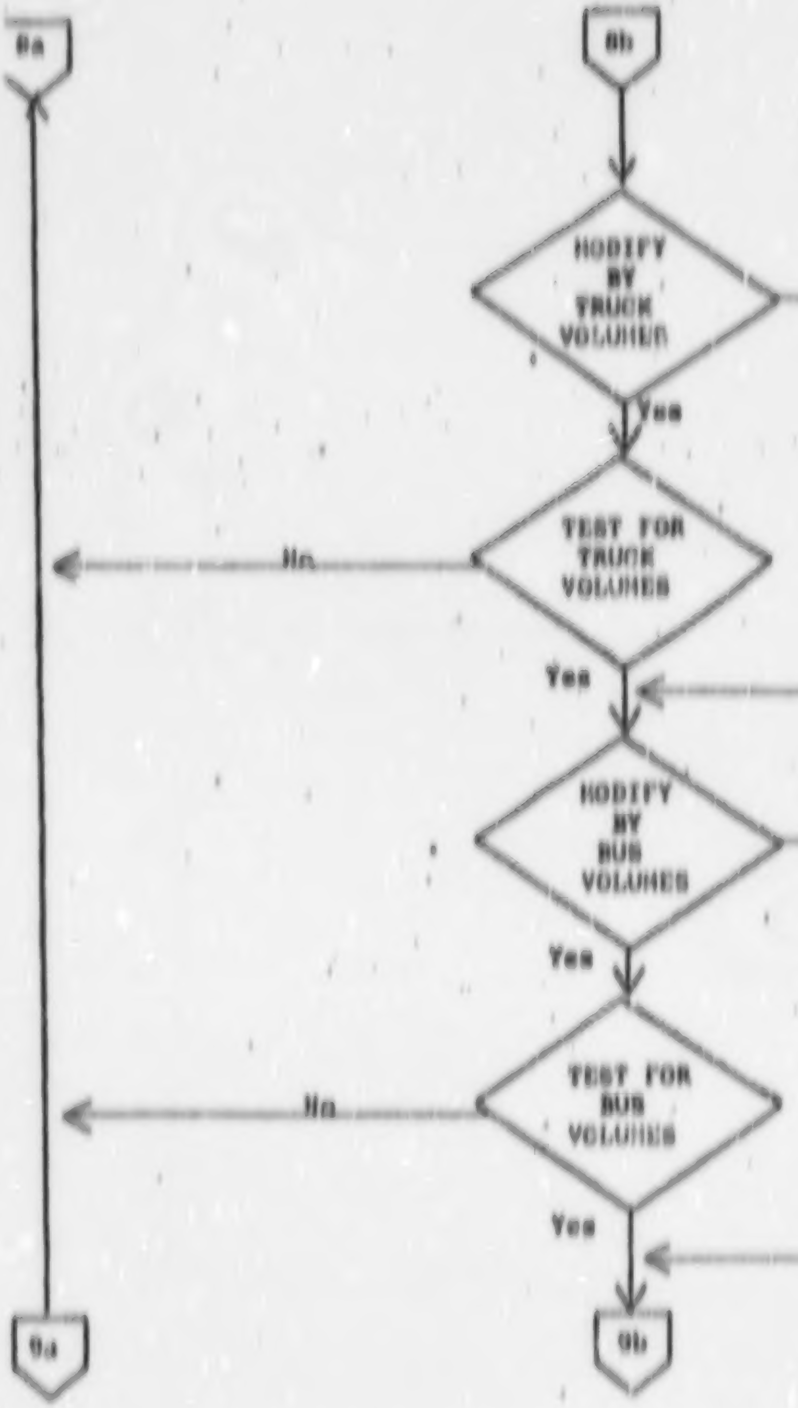

3a
3b
MODIFY BY SPECIAL TOPOGRAPHY
No
Yes
TEST FOR SPECIAL TOPOGRAPHY
No
Yes
MODIFY BY CAPACITY ALTERATIONS
No
Yes
TEST FOR CAPACITY ALTERATIONS
No
Yes
4a
4b

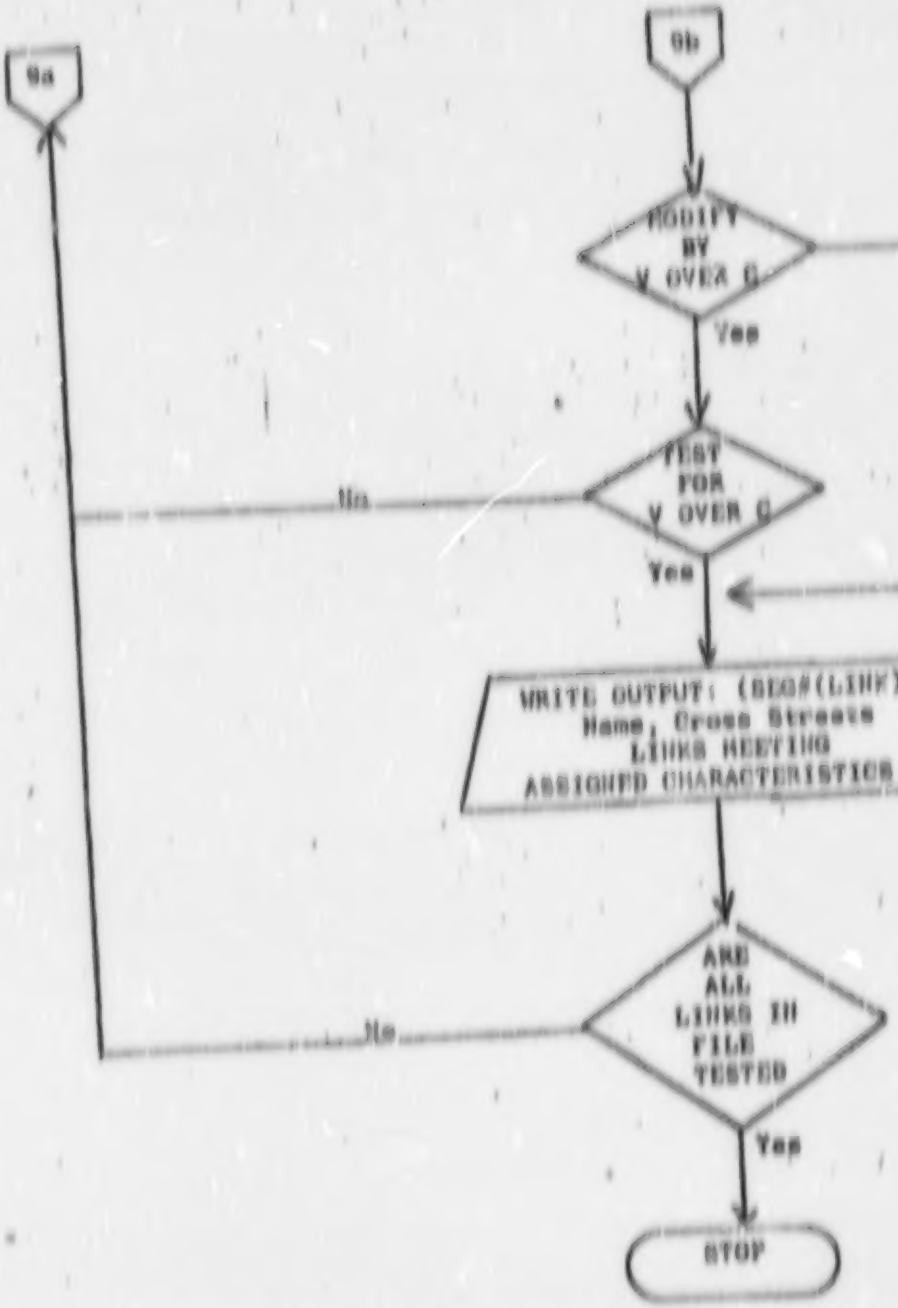

4a
4b
MODIFY BY SENSITIVE LAND USE
No
Yes
TEST FOR SENSITIVE LAND USE
No
Yes
MODIFY BY ACTIVITY CENTERS
No
Yes
TEST FOR ACTIVITY CENTERS
No
Yes
5a
5b


5a
5b
MODIFY BY PROGRESSIVE MOVEMENT
No
TEST FOR PROGRESSIVE MOVEMENT
No
MODIFY BY CHANNELIZATION
No
TEST FOR CHANNELIZATION
No
6a
6b


6a
6b
MODIFY
BY
FUNCTIONAL
CLASS
No
Yes
TEST
FOR
FUNCTIONAL
CLASS
No
Yes
7b


7a
7b
MODIFY BY DISTANCE
No
Yes
TEST FOR DISTANCE
No
Yes
MODIFY BY SPEED DIFFERENCE
No
Yes
TEST FOR SPEED DIFFERENCE
No
Yes
8a
8b


8a
8b
MODIFY BY TRUCK VOLUMES
No
Yes
TEST FOR TRUCK VOLUMES
No
Yes
MODIFY BY BUS VOLUMES
No
Yes
TEST FOR BUS VOLUMES
No
Yes
9a
9b


9a
9b
MODIFY
BY
V OVER C
No
Yes
TEST
FOR
V OVER C
No
Yes
WRITE OUTPUT: (SEG#(LINK)),
Name, Cross Streets
LINKS MEETING
ASSIGNED CHARACTERISTICS
ARE
ALL
LINKS IN
FILE
TESTED
No
Yes
STOP

D.) DEVELOPMENT OF MODAL ANALYSIS EMISSION ANALOGIES

A critical element in this research has been the development of a methodology for the construction of analogies of speed profiles for roadway segments for which no collected speed profile data exist. This analogy development is necessary to allow the use of the Modal Emissions Model to compute emissions for the entire AQCR network, as discussed below.

1. Speed Profile Data

A basic item of data for this research was the speed characteristics study for the St. Louis Region conducted by the East-West Gateway Coordinating Council under contract to the Federal Highway Administration and the Environmental Protection Agency.[3] The study provided second by second speed data over a variety of roadways on 16 different circuitous routes in the St. Louis Region. Each roadway segment was run a total of 12 times. The length of the roadway segments varied from .1 miles to 5 miles. Of the total miles of freeway in the AQCR, approximately 70-80% had speed profile data, while only about 50% of the arterial roadways had adequate speed profile data. Appropriate analogy techniques were developed and used to estimate emissions on these freeway and arterial links not containing speed profile data.

2. Development of the Methodology

Three basic approaches were explored as candidates for analogy development. The first was to attempt to construct second by second speed profiles for roadway segments for which data had not been collected. This approach could proceed by locating a segment of roadway which has similar traffic flow parameter values to the segment in question. The traffic flow parameters most indicative of emissions behavior, are hourly volume, V/C, average speed, and acceleration noise.[4] Since a speed profile has an associated average speed and acceleration noise, it would be possible to physically construct a second by second speed profile of the appropriate length for the segment existing without speed profile data. However, there are two basic problems with this approach: First, the data on which the analogy is based are not uniformly available, and if available, would not likely be applicable to peak hour worst-case conditions. Second, the analogy between the segment with speed profile data and the segment without speed profile data is made on the basis of parameters such as peak hour average speed and the V/C in the peak hour, but a single speed profile is but a single sample from some supposedly stable distribution of possible profiles on a segment. There does not appear to be any direct means of aggregating numerous speed profile samples over the same segment. When this is combined with the specification problem of what constitutes a peak hour average speed or V/C, the technique loses much of its desirability.

The second technique explored, and ultimately employed for arriving at analogies begins by cross-classifying every line source segment in the entire network by three relevant and available indicators of traffic flow quality. These are ADT, V/C, and functional class of roadway. These three parameters imply much of the operational nature of a particular roadway segment. For purposes of this research, four appropriate ranges of ADT were selected for each of three functional classes. In addition, four ranges of V/C were selected, yielding

48 discrete classifications, which, when coupled with the use of peak and off peak descriptors brings the number of possible classes of roadway operation to 96, illustrated in Figure 5. For each of the 48 possible roadway classifications, a segment with existing plausible speed profile data was sought. In actuality, only 29 of the 48 classes are currently in existence in the St. Louis AQCR network. For each of these 29 base segments, two speed profiles were selected, one representing off-peak operating conditions and one representing peak hour operating conditions.

There two speed profiles for each segment were run through the Modal Emissions Model for one vehicle with a reasonable vehicle mix, to arrive at unadjusted emission rates for each of the two profiles for each of the 29 classes. These rates were then adjusted for 75°F ambient temperature and 20% cold operation using adjustment factors from AP-42 Supplement 5, December, 1975. In the emissions computation software, a set of line sources which pass the parameter tests of NETSEN II are checked to see which of the possible classes they are contained in, and the appropriate emission rate is applied to the volume for the hour of interest. The emission computation program, ECOMP, will be dealt with later in this chapter and in the appendices. This second analogy methodology allows the use of appropriate traffic engineering and emissions inputs to the emissions

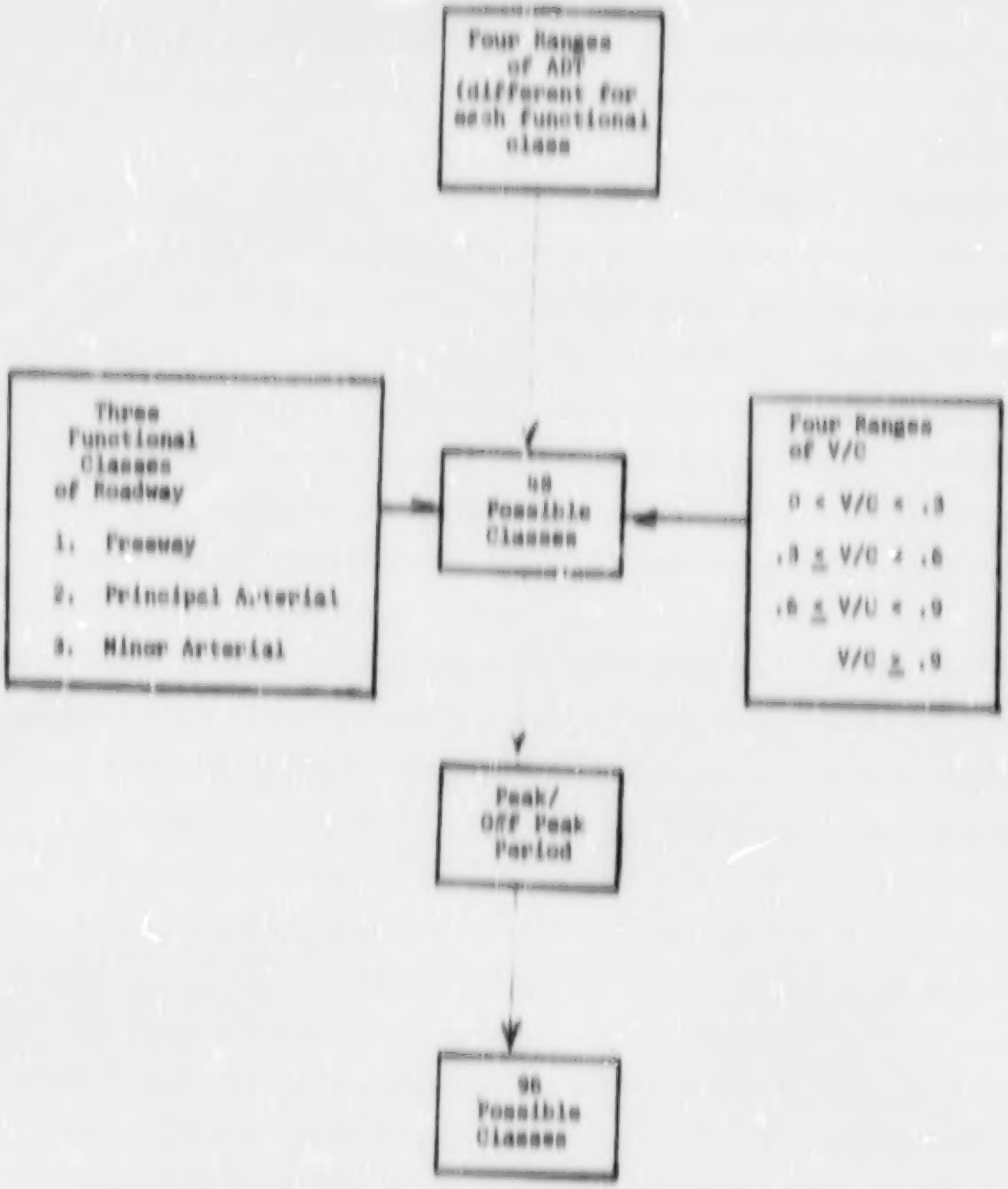

Four Ranges of ADT (different for each functional class
Three Functional Classes of Roadway
1. Freeway
2. Principal Arterial
3. Minor Arterial
48 Possible Classes
Four Ranges of V/C
0 < V/C < .3
.3 ≤ V/C < .6
.6 ≤ V/C < .9
V/C ≥ .9
Peak/ Off Peak Period
96 Possible Classes

FIGURE 5

Modal Emission Analogy Cross-Classification Scheme computation process, while making full use of available data. Based on the number of desired categories of each of the parameters, the classification scheme can be as refined as the user desires and as data will allow.

E. EMISSIONS SOFTWARE SYSTEM

The software system designed to compute emissions for line sources consists of three basic programs shown in Figure 6. The first is the network sorting model NETSEN II which is depicted in block A of Figure 6. The inputs to it consist of appropriate user control cards for selection of line sources and the network roadway inventory. The output of NETSEN II is a set of line sources meeting specified characteristics. These line sources are then passed to the program ECOMP which computes the line source emissions using these line sources as the first input. The second input to the program ECOMP are the emission rates computed by the Modal Emissions Model as shown in block B in Figure 6. The Modal Emissions Program uses the emission coefficients supplied with the model and the peak and off-peak speed profiles from each of the 29 segments identified as representative of each of the analogy classes. In addition, the vehicle mix is assumed to consist of 5% 1957-1967 low altitude vehicles, 5% 1968 low altitude vehicles, 5% 1969 low altitude vehicles, 5% 1970 low altitude vehicles and 80% 1971 low altitude vehicles. This latter percentage was chosen to partially compensate for the fact that all other emission computations are for 1975. The Modal Emission Program results are adjusted for 20% cold operation and an ambient temperature of 75°F and used as input in the ECOMP Program for light duty vehicles. The ECOMP Program uses

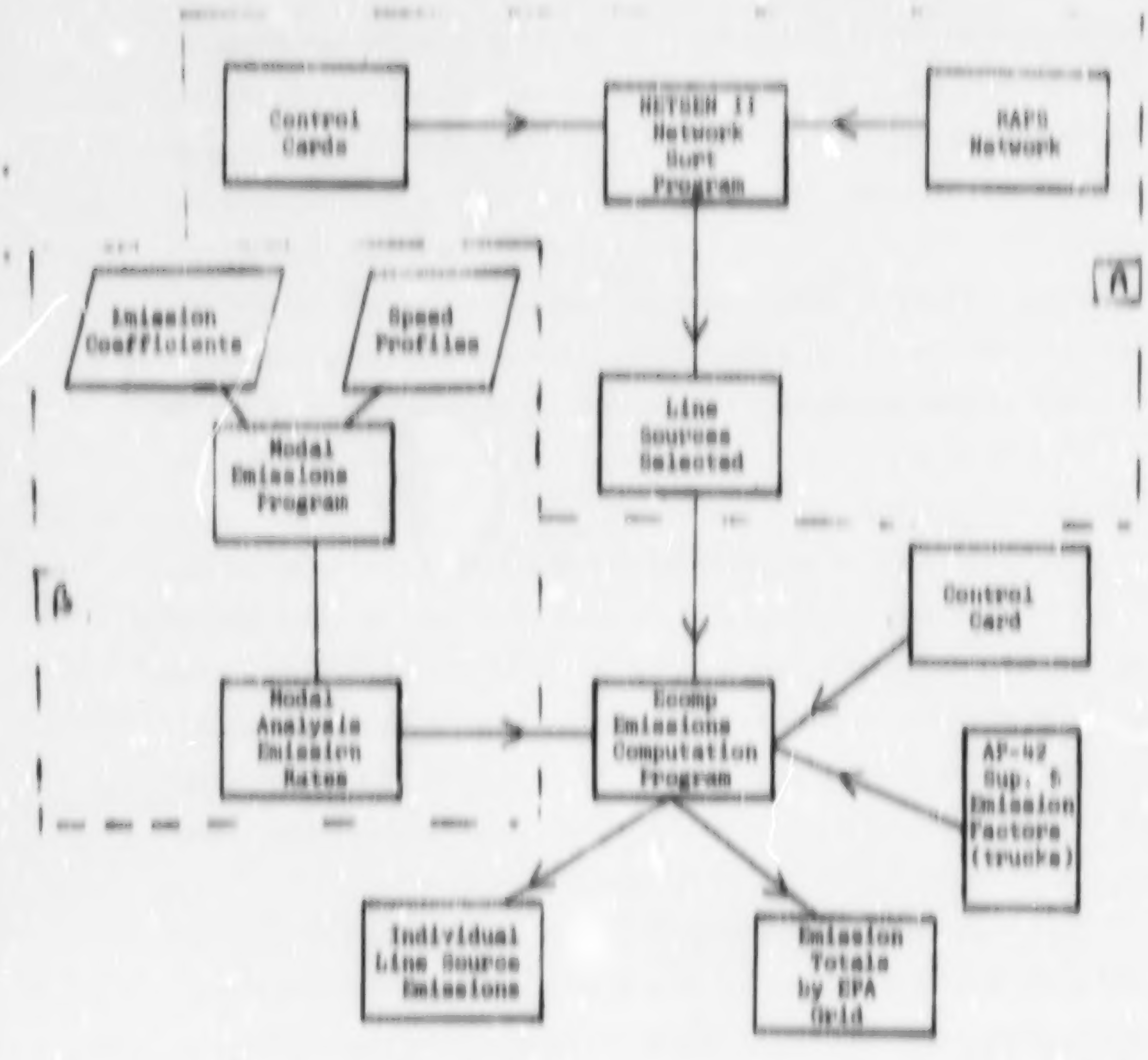

Control Cards
NETSEN II Network Sort Program
RAPS Network
A
Emission Coefficients
Speed Profiles
Modal Emissions Program
Line Sources Selected
B
Control Card
Modal Analysis Emission Rates
Ecomp Emissions Computation Program
AP-42 Sup. 5 Emission Factors (trucks)
Individual Line Source Emissions
Emission Totals by EPA Grid

Figure 6

LINE SOURCE EMISSIONS SOFTWARE SYSTEM

different Modal Emission rates for peak and off-peak period operations.

The third set of inputs to the ECOMP program are the emission factors for trucks computed from AP-42 Supplement 5. For light duty trucks, heavy duty gasoline vehicles, and heavy duty diesel vehicles, separate emission factors were determined for the calendar year 1975 from Supplement 5 using an average speed of 30 miles per hour, an ambient temperature of 75°F and 10% cold operation for light duty trucks. These emission rates were applied to hourly volumes for these three classes of trucks based on an assumed distribution of 5% light duty trucks, 4% heavy duty diesel, and 1% heavy duty gasoline of total vehicles.[5]

The fourth input to the ECOMP Program is a control card to determine the total percentage of all trucks, the hours of the day for which emissions are desired and whether or not emissions are to be added to the grid totals or stored separately as hourly totals. Emissions of SO_2 and particulates were computed in ECOMP based on emission rates for each of the four types of vehicles for the appropriate hourly volumes under consideration. These SO_2 and particulate rates were taken from AP-42 Supplement 5.

The outputs from the program ECOMP consist of three possible types. First, the program outputs on the printer an hourly summary for each line source consisting of geographic information, roadway volumes, functional class, and the emissions totals for the five pollutants. The second type of output is similar to the first except that it is stored on tape for later use. The third type of output is the totaling of all line source emissions for each grid. These latter two outputs are optional and may be specified by the user.

F. EXAMPLE OUTPUT AND DEMONSTRATION OF SYSTEM CAPABILITIES

This section describes several example runs of the software system which illustrate its capabilities. The examples, specified in Table 3 encompass a variety of temporal, geographic, and traffic operations characteristics.

In Example Number 1, the NETSEN II program locates line sources which are freeways, with ADTs in the range 60,000 to 80,000, with V/C s in the range of .60 to .90. There were 57 line sources which fit this description, representing 40.2 kilometers of roadway and 3,469,987 vehicle kilometers of travel (VKT). The program ECOMP computed emissions for this set of line sources for the hours of 4 p.m. to 5 p.m. to 6 p.m., resulting in 271.8 kilograms of HC, 4277.1 kilograms of CO, 367.9 kilograms of NO_x, 14.8 kilograms of SO , and 36.0 kilograms of particulates as shown in Table 3.

The second example consisted of all line sources which were principal arterials, with ADTs in the range of 10,000 to 20,000 and with V/C in the range .30 to .65. These specifications resulted in 114 line sources, representing 81.9 kilometers of roadway and 1,042,982 VKT. The emissions for this set of line sources were computed for 8-9 a.m., resulting in totals of 97.0 kilograms of HC, 1334.1 kilograms of CO, 247.3 kilograms of NO, 2.6 kilograms of SO_2 and 6.4 kilograms of particulates as shown in Table 3.

The third example represents line sources which are minor arterials with ADTs in the range of 15,000 to 20,000 with V/C in the range .6 to .9. These specifications yielded 44 line sources, representing 23.77 kilometers of roadway and 427,201 VKT. The resulting emissions for these line sources during 3-4 p.m. are 42.5 kilograms of HC, 745.6 kilograms of CO, 104.6

Example No.	ADT Range	V/C Range	Functional Class	Other Parameters	No. of Line Sources	VMT	Emissions (Kilograms)				
							HC	CO	NO_x	SO_2	Particulates
1	60,000-80,000	.6-.9	Freeway	4-6 p.m.	57	3,469,987	271.8	4357.1	367.9	24.8	36.0
2	10,000-20,000	.3-.6	Principal Arterial	6-8 a.m.	124	1,042,982	97.0	1334.1	247.3	2.6	6.4
3	15,000-20,000	.6-.9	Minor Arterial	3-4 p.m.	44	427,201	42.5	745.6	104.6	1.1	2.6
4	10,000-20,000	.6-.9	Principal Arterial	Central Business District, 4-6 p.m.	5	88,130	12.7	198.1	25.3	0.36	0.90
5	60,000-80,000	.6-.9	Freeway	8-9 a.m., UTM Coord. Area	4	201,056	9.4	152.9	22.7	0.51	1.2

TABLE 3

EXAMPLE RESULTS FROM EMISSION SOFTWARE SYSTEM kilograms of NO_x, 1.1 kilograms of SO_2 and 2.6 kilograms of particulates as depicted in Table

The fourth example estimates emissions from line sources which are principal arterials, located adjacent to the central business district, with ADTs in the range 10,000 to 20,000 and V/C in the range of .60 to .90. These specifications resulted in the selection of 9 line sources representing 5.85 kilometers of roadway and 88,130 VKT. Emissions computed for these line sources for the hours of 4 p.m. to 5 p.m. and 5 p.m. to 6 p.m. yield totals of 12.7 kilograms of HC, 198.1 kilograms of CO, 25.3 kilograms of NO_x 5.36 kilograms of SO_2 and 0.90 kilograms of particulates as illustrated in Table 3.

The fifth example tested freeway line sources with ADTs in the range of 60,000 to 80,000, with V/C s in the range of .60 to .90. In addition, these line sources were located in an area specified by the UTM coordinates 719.0 km East, 725.0 KM East, 4278.0 Km North and 4291.0 Km North. These characteristics resulted in 4 line sources being selected representing 3.03 kilometers of roadway and 201,056 VKT. Emissions were computed for 8-9 a.m. and produced total emissions of 9.4 kilograms of HC, 151.9 kilograms of CO, 12.7 kilograms of NO_x, 0.51 kilograms of SO_2, and 1.2 kilograms of particulates also shown in Table 3-4.

The above five tests of the line source emission software system illustrate only a small range of the capabilities which can be employed by the user, depending upon the level of refinement of data available on the network. The total emissions for each EPA grid in the St. Louis AQCR for both line and area sources is quite voluminous, and hence has been submitted to EPA on magnetic tape in the Fortran format (I4, 6I7) where the items in order are grid number, VKT, and grams of each pollutant HC, CO, NO_x, SO_2, and particulates. These total emissions are summarized in Table 4 for the RAPS network showing 88,072.86 kilograms of HC, 1,547,482.10 kilograms of CO, 207,353 kilograms of NO_x, 3,763.55 kilograms of SO_2, and 9,189.15 kilograms of particulates. These are emissions resulting from 25,556,736.44 vehicle kilometers of travel. The forthcoming Chapter IV will detail a similar discussion of methodology and example output with respect to non-line/area source emissions for the AQCR.

Type	Kg
HC	48,072.86
CO	1,547,482.10
NO_x	207,353.56
SO_2	3,763.55
Particulates	9,189.15
VKT	25,556,780.44

Time Period: 24 hours, Average Weekday

TABLE 4

FINAL ST. LOUIS AQCR LINE SOURCE EMISSION ESTIMATES

Footnotes Chapter III

[1] Automobile Exhaust Emission Modal Analysis Model, Report from EPA Contract No. 68-01-0435, 1974.

[2] Methodology for the Determination of Emission Line Sources, Environmental Protection Agency Contract No. 68-02-1417, February 28, 1975, p. 40.

[3] FHWA Vehicle Operating Survey conducted in St. Louis under East-West Gateway Coordinating Council.

[4] Acceleration noise is defined as the standard deviation of velocity about the mean.

[5] Air Quality Manual, Illinois Department of Transportation, Policies and Procedures Manual, p. 6-7, April, 1976.

CHAPTER IV

NON-LINE/AREA SOURCE EMISSIONS MODELLING

A) INTRODUCTION - METHODOLOGY DEVELOPMENT

This chapter will illustrate the calculation of grid square emissions for non-line/area source links identified in Methodology for the Determination of Emission Line Sources.[1] These grid square emissions were calculated for the entire St. Louis Air Quality Control Region (AQCR), incorporating relevant vehicle operating characteristics of urban speed profile and percentage of cold start operations. Emissions levels were determined for CO, HC, NO_x, particulate,and SO_2. The output is compatible with that of the line source emissions phase discussed previously. The hour of day and day of week traffic variations employed are identical to those used in the line source emissions analysis.

The methodology employed herein determines a functional relationship between major and minor arterial VKT within the same grid square, as illustrated in Figure 7 . The pollutant level calculations are ultimately derived from an adequate estimation of mobile source VKT on local plus collector roadways, used in conjunction with corrected emission factor estimation equations that are currently available.[2]

The review of St. Louis AQCR non-line/area source VKT information indicated substantial voids in vehicle count data on local and collector roadways. The data was neither uniformly distributed nor truely representative of the study area. At best, after exhaustive field data collection in the St. Louis AQCR, only limited data is available in the most densely populated areas. Finally, it was very difficult to assign and defend a mean trip length to these available volumes.

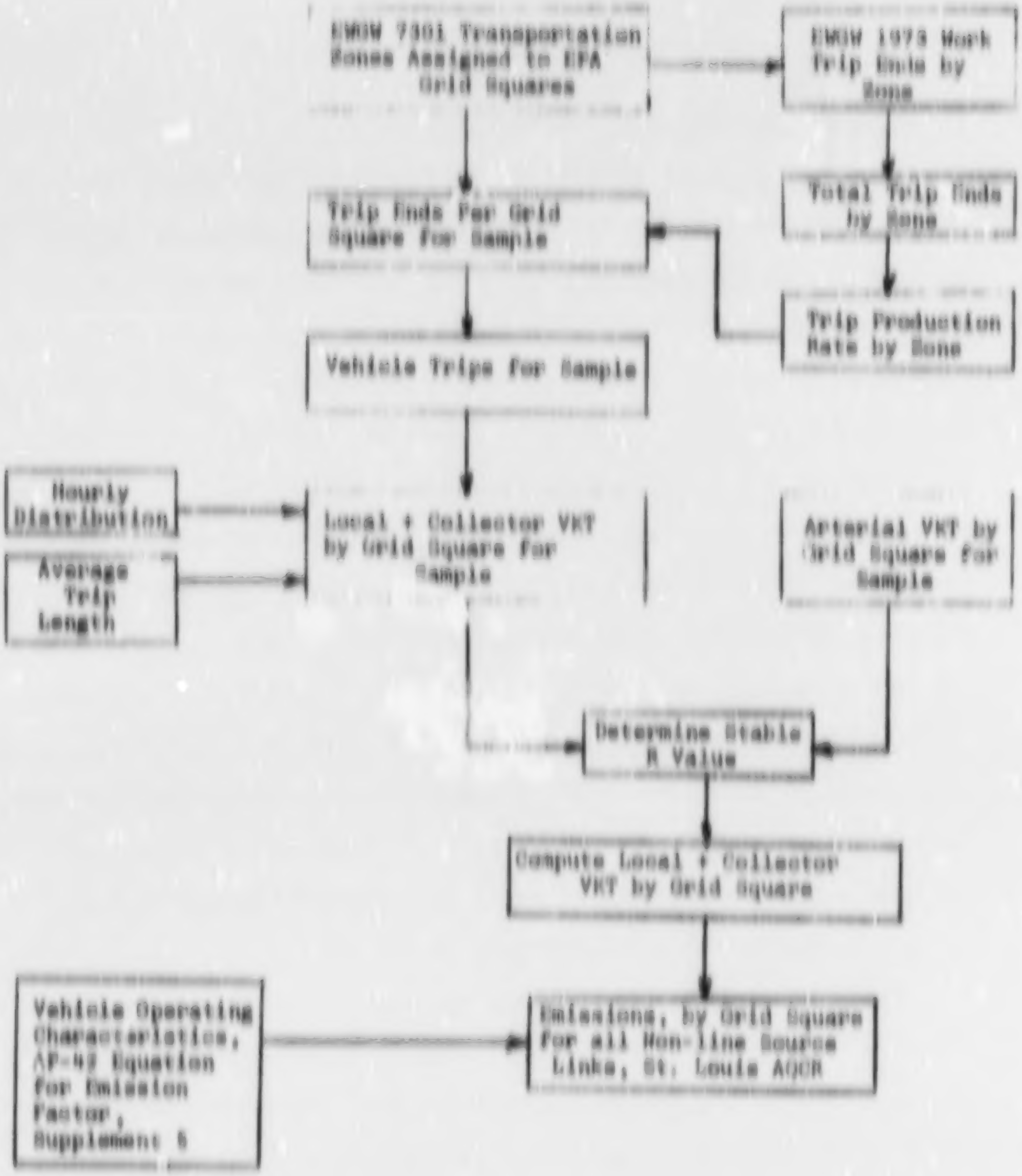

EWGW 7301 Transportation Zones Assigned to EPA Grid Squares
EWGW 1973 Work Trip Ends by Zone
Trip Ends Per Grid Square for Sample
Total Trip Ends by Zone
Trip Production Rate by Zone
Vehicle Trips for Sample
Hourly Distribution
Average Trip Length
Local + Collector VKT by Grid Square for Sample
Arterial VKT by Grid Square for Sample
Determine Stable R Value
Compute Local + Collector VKT by Grid Square
Vehicle Operating Characteristics, AP-42 Equation for Emission Factor, Supplement 5
Emissions, by Grid Square for all Non-line Source Links, St. Louis AQCR

FIGURE 7

Non-Line/Area Source Methodology

For these reasons, the research team developed a trip generation approach to the non-line/area source VKT determination. As shown in Figure 7, East-West Gateway 7301 Transportation Zone existing work trip ends were assigned to a sample of the corresponding EPA grid squares. Further analysis established the vehicle trips per grid square, which, when multiplied by the mean trip length, determined the local plus collector VKT for the sample grid square.

The traffic engineering literature[8] provides estimates of VKT on local and collector roadways in an area as a function of the VKT occuring on principal plus minor arterials in the same area. This relationship is usually expressed as a percentage and is based on stable empirical data taken in various cities over a number of years. This percentage will be referred to as the R value, and is expressed as follows:

$$R = \frac{\text{VKT (Local + Collectors)}}{\text{VKT (Arterials)}}.$$

The determination of the previously defined R value begins with a selection and review of literature pertaining to comparisons of local plus collector VKT to major and minor arterial VKT. This value determined from the literature search is referred to as $\tilde{R}$, and is defensible as the prevailing nationally accepted value.

The verification of this $\tilde{R}$ value as being appropriate for the St. Louis AQCR is a two step procedure. First, the St. Louis AQCR estimate of R, referred to as $\bar{R}$, is calculated from available grid square data as a sample pertinent to this metropolitan study area. The calculation of $\bar{R}$ is an average of all the R values determined for each grid square for which data is available in the St. Louis AQCR.

The second step is a verification of the statistical validity of the use of X as the value for R, i.e. is the value X acceptable for this study area as determined by $\bar{R}$? It is necessary to show that $\bar{R}$ (the local sample ratio) is not statistically different from X (the national ratio) and therefore X can be used for the R value. This is investigated at two confidence intervals, 90% and 95%.

The hypothesis testing employs the standarised normal distribution for a two tailed test. We wish to test the hypothesis:

$$H_0 : \bar{R} = X$$

against the alternative

$$H_1 : \bar{R} = R' \neq X$$

at two significance levels, 10% (90%) and 5% (95%). The actual test calculation is based on the equation

$$|\bar{R} - X| > \frac{\sigma}{\sqrt{n}} (Z_{\alpha/2}) \qquad (1)$$

where

σ = standard deviation within the study sample data

n = sample size

$Z_{\alpha/2}$ = value from the standarised normal distribution function.

If $\bar{R}$ does not satisfy Equation 1, then we accept the hypothesis H_0 at the 10% or 5% level of significance, and use the value X for R. If Equation 1 is satisfied then we must reject X as the value for R due to the peculiarities of the sample data for the study design. A sensitivity analysis employing probabalistic and statistical techniques is then carried out over the range of values between X and $\bar{R}$ to determine a statistically significant value for R. The level of significance (10% or 5%) is the probability of Type I error where we reject H_0 (accept H_1) when H_0 is true.

The estimation of R for the AQCR study region is initiated with a calculation of the local plus collector VKT by grid square. Figure 8 illustrates the calculation procedure. Existing 1973 daily work trip ends, developed by East-West Gateway Coordinating Council, are used to determine a rate factor, work trip ends per acre, for each of the internal zones of the 7301 system. Concurrently, these transportation zones are assigned to the EPA grid squares and the grid square sample developed. Together, these steps formulate a set of work trip ends for each of the sample grid squares. The work trip ends are expanded to total person trips[4] using the distribution of trip purposes shown in Table 5 . As shown, work trips were considered to compose 37% of the total of all trips made. Subsequently, transit trips are factored from total person trips from the sample grid squares. For purposes of this analysis, auto trips were assumed to be 0.80 of the total person trips.[5] Previous research for the St. Louis AQCR indicates a vehicle occupancy of 1.4 persons per vehicle for the study area.[6] This factor, applied to the auto person trips for each of the sample grid squares, yields the total vehicle trips. A mean trip length is then applied to the vehicle trips to arrive at the daily VKT for the local plus collector roadway segments within the sample grid squares. For this study approach to non-line/area source travel activity, the trip length (L_t) was assumed to be a value ranging from one half the grid side length to the grid diagonal length.[7] In a numerical format, with L as the length of the grid square side, the range in value for L_t can be expressed as

$$0.500L \leq L_t \leq 1.414\,L$$

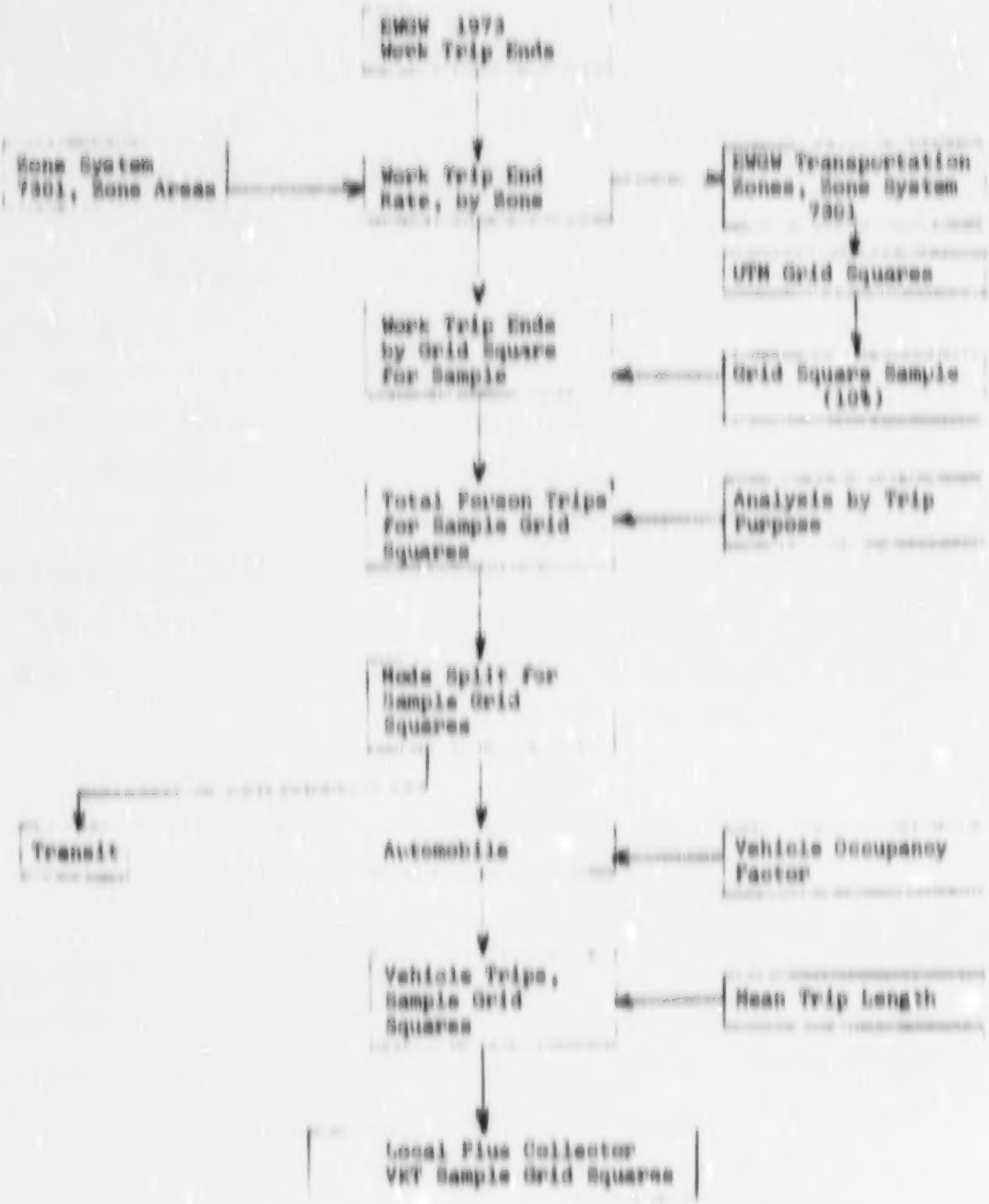

EWGW 1978
Work Trip Ends
Zone System
7801, Zone Areas
Work Trip End
Rate, by Zone
EWGW Transportation
Zones, Zone System
7801
UTM Grid Squares
Work Trip Ends
by Grid Square
for Sample
Grid Square Sample
(10%)
Total Person Trips
for Sample Grid
Squares
Analysis by Trip
Purpose
Mode Split for
Sample Grid
Squares
Transit
Automobile
Vehicle Occupancy
Factor
Vehicle Trips,
Sample Grid
Squares
Mean Trip Length
Local Plus Collector
VKT Sample Grid Squares

FIGURE 8 Local Plus Collector VKT, Sample Grid Squares

TABLE 5

ANALYSIS OF TRIP PURPOSE

Persons per Household*	Purpose of Journey													
	To Work		On Business		Shopping		Education		Social-Recreation		Other, Unclassified		Total	
	Trips per Household	Percentage of All Trips	Trips per Household	Percentage of All Trips	Trips per Household	Percentage of All Trips	Trips per Household	Percentage of All Trips	Trips per Household	Percentage of All Trips	Trips per Household	Percentage of All Trips	Trips per Household	Percentage of All Trips
1 ([illegible])	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2 ([illegible])	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3 ([illegible])	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4 ([illegible])	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5 ([illegible])	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6 ([illegible])	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7 ([illegible])	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8 ([illegible])	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mean*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

*Figures in parentheses give number of households in the group.

(Source: Table 5.15, p. 260, Transportation and Traffic Engineering Handbook, Institute of Traffic Engineers, 1976.)

Table 6 presents the sample grid squares used, work trip ends, and local plus collector VKT.

The final task of the determination of R for the study region was to calculate $\bar{R}$, from the sample grid squares, and determine N, the national percentage. To reiterate, R is defined to be the ratio

$$R = \frac{\text{VKT (local plus collector)}}{\text{VKT (principal plus minor arterial)}}$$

and N is a national figure which the research team attempted to verify from the sample grid squares for use in the study region as the value for R. Table 7 presents ranges in the extent of various urban roadway system components. From the table a mean value of 40% was constructed for N, i.e. in a given grid square, the local plus collector VKT was 40% of the VKT resulting from travel on principal plus minor arterials within the same grid square. Figure 9 further details the determination of R for the St. Louis AQCR, and will be discussed below.

From the grid square sample collected, a value of $\bar{R}$ equal to 0.1696 (standard deviation 0.0771) was calculated. By the statistical testing procedure previously described, the hypothesis H_o, where

$$H_o: \bar{R} = N$$

is tested against the alternative

$$H_1: \bar{R} = R \neq N$$

at the 10% and 5% level of significance, and for the actual test equation

$$|\bar{R} - N| > \frac{\sigma}{\sqrt{n}} (Z_{\alpha/2}).$$

TABLE 5 SAMPLE GRID SQUARES

Grid Square Number	Work Trip Ends	Local plus Collector VKT
118	120	370,8
134	37	285,8
166	568	4387,8
228	1840	5685,0
246	805	1243,7
259	642	491,9
285	472	1458,5
314	1206	725,6
336	367	565,2
346	377	581,7
375	287	463,4
385	600	926,9
404	1561	2411,5
414	136	309,6
430	803	1238,7
440	335	517,6
450	1579	2439,6
477	1119	1728,6
487	2090	3229,1
505	974	1504,6
515	1203	1858,1
525	49	75,3
548	1540	2379,3
558	1661	2564,6
569	25	38,6
579	1587	2388,0
589	1476	2280,4
599	1161	1792,2
609	3933	6075,9
618	579	894,9
637	904	1396,5
647	1691	2611,7
657	1252	1933,4
667	1184	1827,5
677	2104	3249,5
687	1312	2026,9
704	988	1526,3
714	1856	2864,2

TABLE 6   Continued

Grid Square Number	Work Trip Ends	Local plus Collector VKT
724	892	1377,7
734	1277	1972,8
745	1283	1982,0
756	383	591,6
766	1393	2150,1
776	384	593,2
786	3212	4962,0
796	3047	4707,6
806	692	1066,8
818	1411	2179,8
828	1156	1785,1
838	1304	2019,[illegible]
848	1675	2585,[illegible]
858	4278	6608,1
868	1788	2760,1
887	1847	2853,6
897	6420	9918,0
907	1506	2326,8
925	2534	3914,0
935	4273	6601,1
945	1292	1996,1
961	8059	12448,5
971	709	1095,4
996	184	506,3
1006	4380	6765,9
1016	363	560,8
1034	9970	15401,7
1044	8779	13562,4
1067	495	464,8
1104	221	341,5
1119	1326	2048,6
1129	1203	1858,1
1151	438	677,1
1161	464	716,9
1171	840	1297,6
1188	1447	2235,6
1198	82	126,7
1218	2813	4345,0
1228	781	1205,8
1239	306	471,0

TABLE 6   Continued

Grid Square Number	Work Trip Ends	Local plus Collector VKT
1251	675	4365,0
1261	1070	1650,9
1271	702	1083,3
1281	738	1139,8
1291	927	1432,2
1301	902	1391,8
1315	868	1340,0
1325	210	322,6
1335	183	282,6
1345	194	299,7
1355	153	235,5
1365	183	282,7
1381	69	106,6
1393	1032	7971,7
1403	353	544,0
1419	1099	6789,5
1434	151	233,1
1444	165	508,7
1458	22	33,0
1468	225	347,6
2084	5	7,7
2102	121	372,1
2120	58	89,6
2138	89	273,2
2163	1838	5677,9
2181	952	2941,4
2198	174	536,9
2215	1050	3242,8
2231	863	1333,3
2255	5195	16049,3
2265	571	880,8
2284	794	2451,6
2294	519	801,9
2322	35	54,2
2332	154	237,9

System	Range (percent)	
	Vehicle Miles of travel (%)	Miles
Principal arterial system	40-55	5-10
Principal arterial plus minor arterial street systems	65-75	15-25
Collector street system	5-10	5-10
Local street system	15-30	65-80

TABLE 7 EXTENT OF URBAN FUNCTIONAL SYSTEMS

(Source: Table C-2, p. 112, *A Policy on Design of Urban Highways and Arterial Streets*, American Association of State Highway Officials, 1973.)

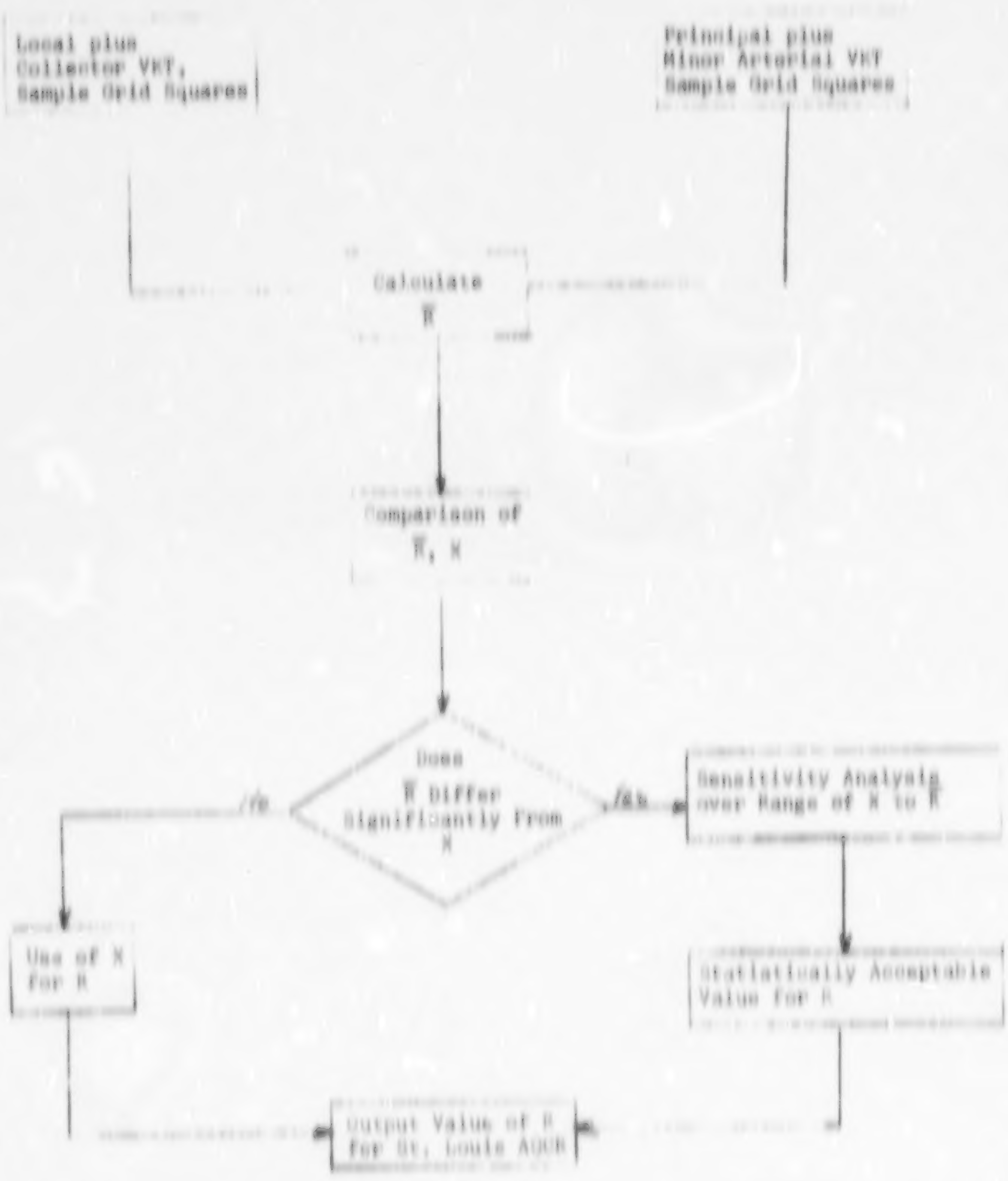

Local plus Collector VKT, Sample Grid Squares
Principal plus Minor Arterial VKT Sample Grid Squares
Calculate $\bar{R}$
Comparison of $\bar{R}$, K
Does $\bar{R}$ Differ Significantly From K
No
Yes
Sensitivity Analysis over Range of K to $\bar{R}$
Use of K for R
Statistically Acceptable Value for R
Output Value of R for St. Louis AQCR

Figure 9

Calculation of R for Study Area

of these tests, the values of $Z_{\alpha/2}$ from the standarized normal distribution are presented in Table 8 below.

Level of Significance	$(Z_{\alpha/2})$
5%	1.960
10%	1.645

TABLE 8

TEST STATISTICS, STANDARIZED NORMAL DISTRIBUTION

For Case 1, (5% level of significance) the test equation results in

$$|.1696 - .4000| > \frac{.0771}{\sqrt{88}}\ (1.960)$$

$$0.259 \quad > 0.016$$

indicating reject H_0 and accept H_1. Similarly, for case 2, (10% level of significance) the value of the test equation is

$$|.1696 - .4000| > \frac{0.0771}{\sqrt{88}}\ (1.645)$$

$$0.259 \quad > 0.014$$

again indicating reject H_0, accept H_1. The next step is to establish a value for R', a statistically reliable value for R, from a sensitivity analysis over the range $\overline{R}$ to R, (from 0.1696 to 0.4000). The results of such analyses yield the following values for R' at the respective significance levels:

Level of Significance	R'
5%	0.1856
10%	0.1836

The significant departure of K for the St. Louis AQCR study region from the national value of K is illustrated by the distribution of local and collector roadways across the region. A review of the data distribution for the study region indicates that for sample grid squares in closer proximity to the urban core, the local plus collector VKT is a higher percentage of the principal plus minor arterial VKT than for other sample points.

B) USE OF GRID SYSTEM

In calculating the local plus collector roadway VKT previously described, it was readily apparent that the UTM grid system did not correspond to other conventional regional classification systems, such as transportation zones, census tracts, etc. As a result, a conversion of relevant information on local plus collector VKT was required from existing data, and the respective classification system, to UTM coordinates and grid squares.

After thorough analysis, the research team determined that the most relevant classification system was the current East-West Gateway Transportation zone mapping system, Regional Transportation Zones, Internal and External, Zone System 7301. From the topographical maps of the study region, the UTM coordinates were transferred to the regional transportation zone map. The base line for the conversion was the county line between Franklin and Washington Counties. This was verified against a portion of the line between Franklin and St. Louis Counties.

A visual geometric approximation procedure was used to assign the 7301 transportation zones to the corresponding EPA grid squares. For example, grid square 567 (with the following coordinates for the south-west corner: East-West, 730.0; North-South, 429.8) can be schematically represented in Figure 10. After inspection, the total grid square area was broken into contributions from the various transportation zones, resulting in the composition shown in Table 9 .

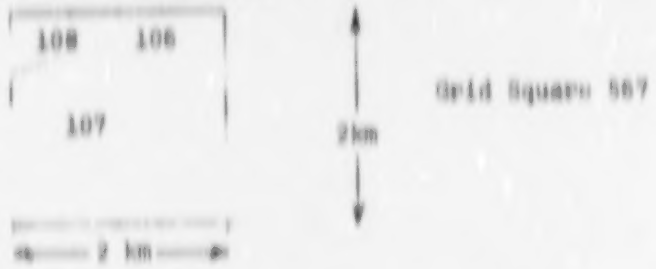


FIGURE 10

Representative UTM Grid Square, Showing 7301 Transportation Zones

Grid Square	Transportation Zone	Area Percent
567	106	30
	107	60
	108	10

TABLE 9 EXAMPLE GRID SQUARE AREA ANALYSIS

These percentage factors are applied to the appropriate total grid square area to arrive at the area contributions by the corresponding transportation zones. Table 10 presents the results of the area contribution by each zone km^2 for the example. Table 11 presents base values of the areas for various size EPA grid squares.

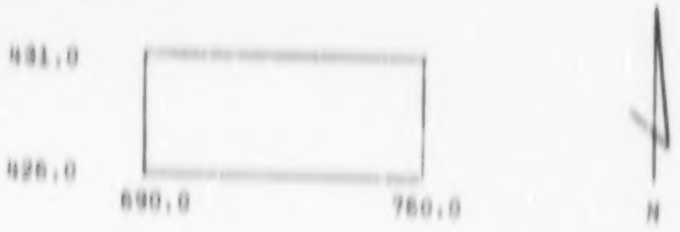
Grid Square	Transportation Zone	Area	
		Acres	km^2
567	106	296.5	1.2
	107	593.0	2.4
	108	98.8	0.4
Total		988.3	4.0

TABLE 10 EXAMPLE GRID SQUARE AREA

Length of Side, Grid Square km	Area	
	Acres	km^2
1	247.1	1
2	988.4	4
3	2223.9	9
4	3953.6	16
5	6177.5	25
6	8895.6	36
10	24710.0	100

TABLE 11 GRID SQUARE AREAS

The geographic limits for the grid square sample were set after analysis of mobile source activity within the St. Louis AQCR. The research team determined that an analysis of the travel activity in the EWGW 7301 Internal Zone System would accurately determine the empirical relationship between local plus collector and principal plus minor arterial VKT. Individual grid square associations between respective VKT totals beyond this cordon subregion were considered to fall at the tail of the assumed normal distribution and would, as a result, not be of significance in formulating the value, $\overline{R}$, previously defined. Therefore, the 10% sample was drawn from within a cordon of the UTM coordinates schematically presented below:



which closely correspond to the internal zones of the 7301 transportation zone system.

C) EXAMPLE OUTPUT

With the R value computed as in the previous section, the local plus collector VKT was determined by applying the R factor to the sum of principal plus minor arterial VKT. Equivalently, the travel activity for each of the EPA grid squares in the AQCR can be expressed as:

VKT (local plus collector) = R x VKT (principal plus minor arterial)

Figure 11 details the ultimate emissions estimation procedure. Given the above VKT, the next step is the calculation of a composite emissions factor. Assumptions on factors used in developing the final composite factor were compatible with the assumptions used in the line source calculations. The average speed, determined from the urban speed profile, is 30.57 kph (19.0 mph).[9] A percentage cold operation factor of 0.80 was used, which reflects the higher level of start up operations associated with

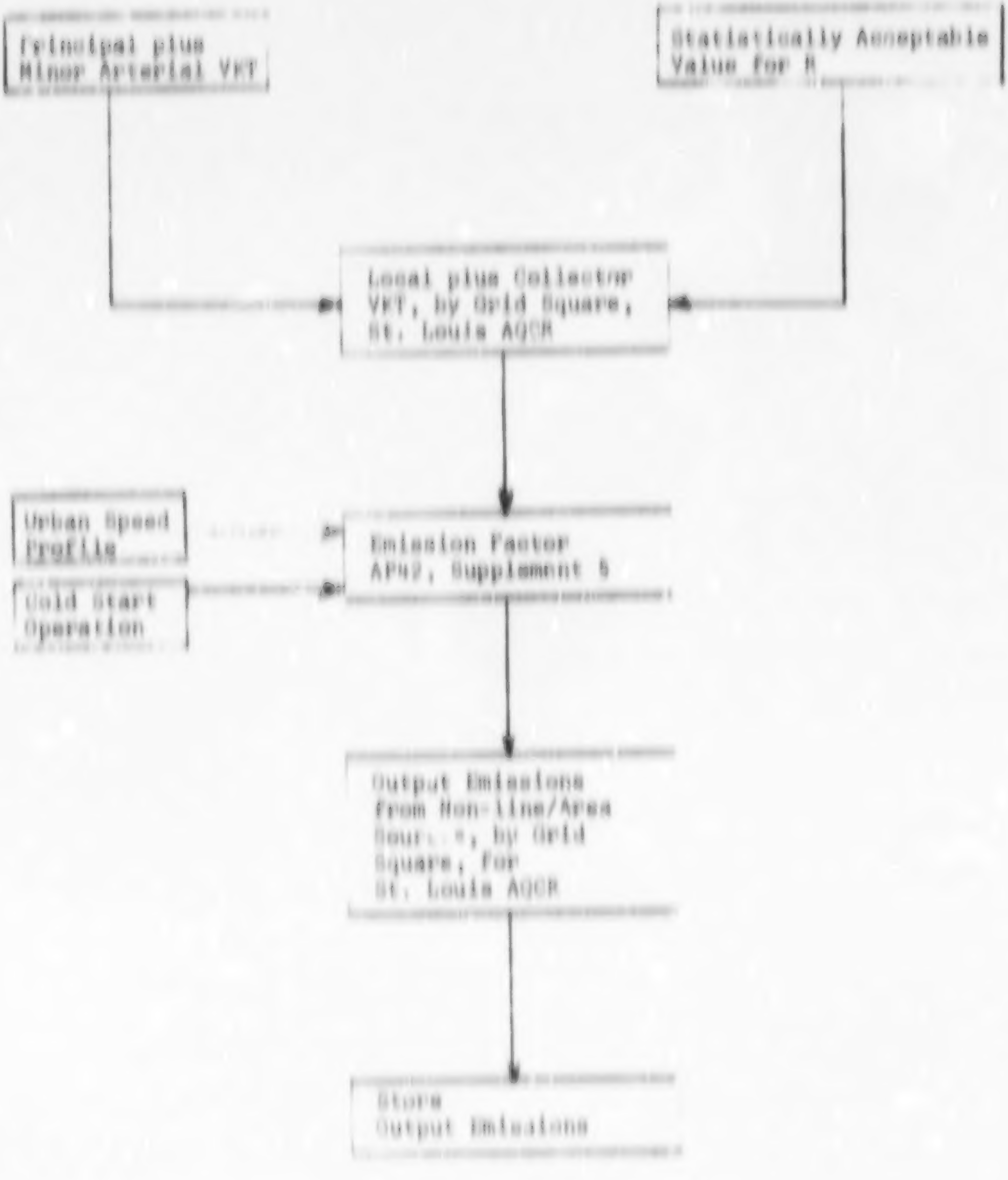

Principal plus Minor Arterial VMT
Statistically Acceptable Value for R
Local plus Collector VMT, by Grid Square, St. Louis AQCR
Urban Speed Profile
Cold Start Operation
Emission Factor AP42, Supplement 5
Output Emissions from Non-line/Area Sources, by Grid Square, for St. Louis AQCR
Store Output Emissions

FIGURE 11

Non-Line/Area Source VMT Calculation

vehicle trips that begin on local or collector roadway links.[10] The final set of composite factors are presented in Table 12 below.

TABLE 12 COMPOSITE EMISSION FACTORS

Pollutant	Emission Factor	
	gm/km	gm/mi
CO	38.716	62.294
HC	2.615	4.207
NO_x	0.874	1.407
SO_2	0.080	0.129
Particulate	0.330	0.531

Table 13 is presented as an example of the hourly variation and 24 hour emissions for a typical grid square due to non-line/area source travel activity. The determination of the hourly VKT assumes the same hourly distribution of VKT activity used in the line source analysis. Hour 24 is the total daily VKT and emissions for the sample grid square.

TABLE 13 REPRESENTATIVE AREA SOURCE EMISSIONS

Grid Square Number	Local Plus Collector VKT	Hour	Emissions kg				
			HC	CO	NO_x	SO_2	Part.
101	9.11	0	0.024	0.353	0.008	0.001	0.003
	6.11	1	0.016	0.237	0.005	0.000	0.002
	2.85	2	0.007	0.110	0.002	0.000	0.001
	1.55	3	0.004	0.060	0.001	0.000	0.001

TABLE 13 continued

Grid Square Number	Local Plus Collector VKT	Hour	Emissions kg				
			HC	CO	NO_x	SO_2	Part.
101	1.24	4	0.003	0.048	0.001	0.000	0.000
	3.47	5	0.009	0.134	0.003	0.000	0.001
	14.55	6	0.038	0.563	0.013	0.001	0.005
	30.60	7	0.080	1.185	0.027	0.003	0.010
	27.60	8	0.072	1.069	0.024	0.002	0.009
	22.99	9	0.060	0.890	0.020	0.002	0.008
	24.13	10	0.063	0.934	0.021	0.002	0.008
	26.62	11	0.070	1.030	0.023	0.002	0.009
	29.21	12	0.076	1.131	0.026	0.002	0.010
	27.65	13	0.072	1.071	0.024	0.002	0.009
	28.95	14	0.076	1.121	0.025	0.002	0.010
	34.80	15	0.091	1.347	0.030	0.003	0.011
	41.01	16	0.107	1.588	0.036	0.003	0.014
	41.17	17	0.108	1.594	0.036	0.003	0.014
	33.66	18	0.088	1.303	0.029	0.003	0.011
	32.10	19	0.084	1.243	0.028	0.003	0.011
	26.51	20	0.069	1.026	0.023	0.002	0.009
	22.78	21	0.059	0.878	0.020	0.002	0.007
	17.04	22	0.045	0.660	0.015	0.001	0.006
	12.22	23	0.032	0.473	0.011	0.001	0.004
Total	517.82	24	1.354	20.048	0.453	0.041	0.171

Such individual non-line/area source grid analysis has been performed for each of the 1,987 grids in the St. Louis AQCR and summarized over the entire region. This analysis has been submitted to the agency on magnetic tape, and is exhibited in Table 14. These total daily emissions due to non line/area source activity can be added to grid square emissions arising from line source activity or summed over the entire region.

TABLE 14 ST. LOUIS AQCR TOTAL EMISSIONS DUE TO NON-LINE/AREA SOURCES

Local Plus Collector VKT	Emissions (kg)				
	HC	CO	NO_x	SO_2	Part.
3,633,392.0	9502.543	140,680.063	3176.256	290.726	1199.210

Footnotes Chapter IV

[1] Methodology for the Determination of Emission Line Sources, Environmental Protection Agency Contract No. 68-02-1417, February 28, 1975.

[2] $e_{npstwx} = \sum_{i=n-12}^{n} c_{ipn} m_{in} v_{ips} z_{ipt} r_{iptwx}$

where e is the composite emissions factor after various adjustments from Supplement No. 5 for compilation of Air Pollutant Emission Factors, Second Edition, page D3.

[3] A Policy on the Design of Urban Highways and Arterial Streets, American Association of State Highway Officials, 1973.

[4] Transportation and Traffic Engineering Handbook, Institute of Traffic Engineers, 1976.

[5] Ibid.

[6] See Footnote 1.

[7] Although numerous studies have dealt with trip length, little attention has been developed to trips on various segments links. The average value L_t must reflect consideration of the number of intrazonal trips as well as the distribution of route miles for local plus collector systems. Therefore, the research team determined that the value $L_t = L$ would adequately reflect these factors as well as the nature of travel activity on local plus collector roadways.

[8] See footnote 2.

[9] This value of 30.57 kph (19.0 mph) is the default value in the AP42, Supplement 5, emissions calculation, as seen in footnote 2.

[10] This factor was constructed from information presented in Transportation and Traffic Engineering Handbook, Institute of Traffic Engineers, 1976.

CHAPTER V

CONCLUSION

In concluding this research endeavor, it is pertinent to summarize the methodological developments and findings which have resulted,and offer comment on worthwhile future research efforts with respect to mobile source air pollution emissions estimation.

A) Present Methodological Developments, Their Use and Applicability

The data analysis and modelling efforts of the project yielded several tangible outputs. They are:

1.) An updated and refined version of the NETSEN Model, termed NETSEN II, which is capable of defining line sources at any level of data refinemunt, and inputting such line sources to a variety of emissions models, in this particular case, integrating with the Modal Emissions Model, using speed profile as the key linking variable.

2.) Through intugration of NETSEN II and the Modal Emissions Model, the development of a truly microscale emissions estimation model, which allows emissions to be analyzed as a function of highly localized traffic operating conditions and roadway descriptions.

3.) The ability to develop accurate analogies of speed profile and emissions characteristics for links not possessing speed profile field data. These analogies are built by appropriate analysis of cross classified links possessing speed profile data, over a range of ADT, V/C and functional class.

4.) Based on the use of information developed from 1-3 above, an exhaustive and accurate statement of emissions resulting from line sources in the St. Louis AQCR. This statement encompasses the sources, descriptions, attributes, and total emissions for CO, HC, NO_x, SO_2, and particulates resulting from 1370 miles of roadway, composed of 195 miles of freeways and 1175 miles of principal and minor arterials.

5.) The development of a valid statistical sampling routine which allows the regional distribution of local and collector streets to be tested against a national value, thus allowing use of appropriate trip generation information in designing non-line/area source emission contributions.

6.) The development, in conjunction with 5 above, of a trip generation approach which viably takes into account the land use of the region, cold-start phenomena, and the distribution of local and collector streets to yield non-line/area source emissions at an EPA grid, and regional summary level.

B) Recommendations for Future Research

In developing the above methodological approaches, and in analysis of their resultant output, the research team has catalogued items which are deemed worthy of further research, and will maximize gains from present knowledge and efforts. They are:

1.) Continuing research into very refined measurement of second by second speed profiles for an exhaustive set of geometric design - traffic operations combinations, such as one way streets, progressive signalization systems, links crossing intersections with channelized and/or signalized turn lanes, i.e., development of a "case book" of speed profile typology, possibly for cities of varying size and urban characteristics, much as the Highway Capacity Manual classifies conditions for design and capacity analysis.

2.) Continuing research into speed profile and emission characteristics and the potential capability for study of them, with speed and delay - related traffic flow theories, such as acceleration noise, freeway shock-wave phenomena, and queuing theory.

3.) The testing of normality or other distribution assumptions with respect to spatial incidence of local and collector streets across a metropolitan region, possibly with several types of regional growth patterns, thus yielding more accuracy and insight into the emissions producing behavior of non-line/area mobile sources for different metropolitan land uses and/or growth patterns and policies.

C) Closing Comments - Status of Line and Non-Line Mobile Source Emission Modelling

In final conclusion, a fundamentally sound analytic approach has been developed to accurately estimate line source emissions at a microscale level, and to test the incidence of non-line/area mobile sources, and their resultant emissions. Continuing effort should be made to develop data bases which are complete and accurate in their description of relevant traffic flow behavior for line sources, and are valid in their employment of land use, trip generation, and local collector street information in non-line/area source analysis.

Selected Research Bibliography

A Study of Traffic Flow on a Restricted Facility, Interim Report Phase One, Department of Civil Engineering, University of Maryland, College Park, Maryland, June 1973.

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APPENDIX A

NETSEN II: COMPUTER PROGRAM DOCUMENTATION

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A-1 NETSEN II: PROGRAM EXPLANATION

NETSEN II or Network Sensitivity Program II, is more advanced version of the NETSEN program produced for EPA under Contract No. 68-02-1417. NETSEN II like NETSEN is designed to receive an input roadway network and, from it, select a subset of the network with certain common characteristics.

The program has two basic inputs, a set of control cards and the roadway data card file. The program begins by reading the first control card (illustrated on page 111 of this appendix) which tests to see if the user wishes to have a copy of the roadway inventory file printed out. This subroutine is activated by a 'YES' being printed in the first three columns of the first control card. An example of the output appears on page 127. Each link in the roadway inventory will have a corresponding sheet for it. If no test is to be done, then a blank control card or a 'NO0' should be entered on the first control card.

The GRIDRT subroutine is activated by a 'YES' in its first three columns of the second control card. If the value is 'YES' it activates a routine for testing for a specific grid or set of grids. If a grid is to be tested for, the grid number should be placed on a separate computer card in the first five columns of the card, and should be right justified. If more than one grid is to be tested the numbers should be placed in ascending order on separate cards. At the end of the set of cards with grid numbers to be tested a card with a 99999 in the first five spaces should be entered. An example of the output appears on page 133. If no test is to be done for grid numbers, a blank card should be entered or a 'NO0' should be entered on the second control card.

The LINKRT subroutine card is activiated by a 'YES' in its first three columns of the third control card. If the value is 'YES' it activates a routine for testing for a specific link or set of links. If a link is to be tested for,the grid number should be placed on a separate computer card in the first five columns of the card and should be right justified. If more than one link is to be tested, the numbers should be placed in ascending order on separate cards. At the end of the set of cards with link numbers to be tested,a card with a 99999 in the first five spaces should be entered. An example of the output appears on page135. If no test is to be done for link number a blank card should be entered or a 'NO0' should be entered on the third control card.

The NETSRT subroutine is also activated by a 'YES' in the first three columns of the fourth control card. If the value is 'YES' it activates the network sorting subroutine. If the routine is activated then the program reads in two more control cards containing the parameters to be tested. For the format for these two cards, see Pages 112 to 117. The explanation of the various parameters which can be tested appears on pages 121 to 124. If the user wishes to test for certain parameters he enters these in the approriate columns of the control cards. If the user does not want to test for a variable, he enters zeros on the control card, or leaves the columns blank and the subroutine will not perform these tests and the program is finished.

When the subroutine is activated by a 'YES' then the routine begins by reading the two final control cards which have certain parameters on them for which the subroutine will test the roadway inventory (data cards). The subroutine then moves to a point where the data cards are read in. At this point, the subroutine enters a loop, and continues until the last data card is read and tested.

The tests which are performed include a test for ADT, speed difference, truck volumes, bus volumes, V/C ratio, link distance, and a coordinate test. In testing for these, the user specifies the range for which he wishes to test. For example, if the user would like to test ADT for volumes of 0 to 20,000, he enters 0 in ADTLW and 20,000 in ADTHI. For volumes 19,963 to 23,227 he enters these numbers in the appropriate variables. If the user does not want to test a variable, he enters zeros on blanks in both variables and the program will not perform these tests.

There is one error routine and this is contained in the V/C ratio test. This error routine performs a test on the capacity to make sure it is not zero if a peak hour volume exists. This test prevents the program from not running because of a division by zero error. The test will print a message which will contain the link number of the link and a statement, '***ERROR***; DIVISION BY ZERO.' The subroutine prints the message and then goes back and reads another data card.

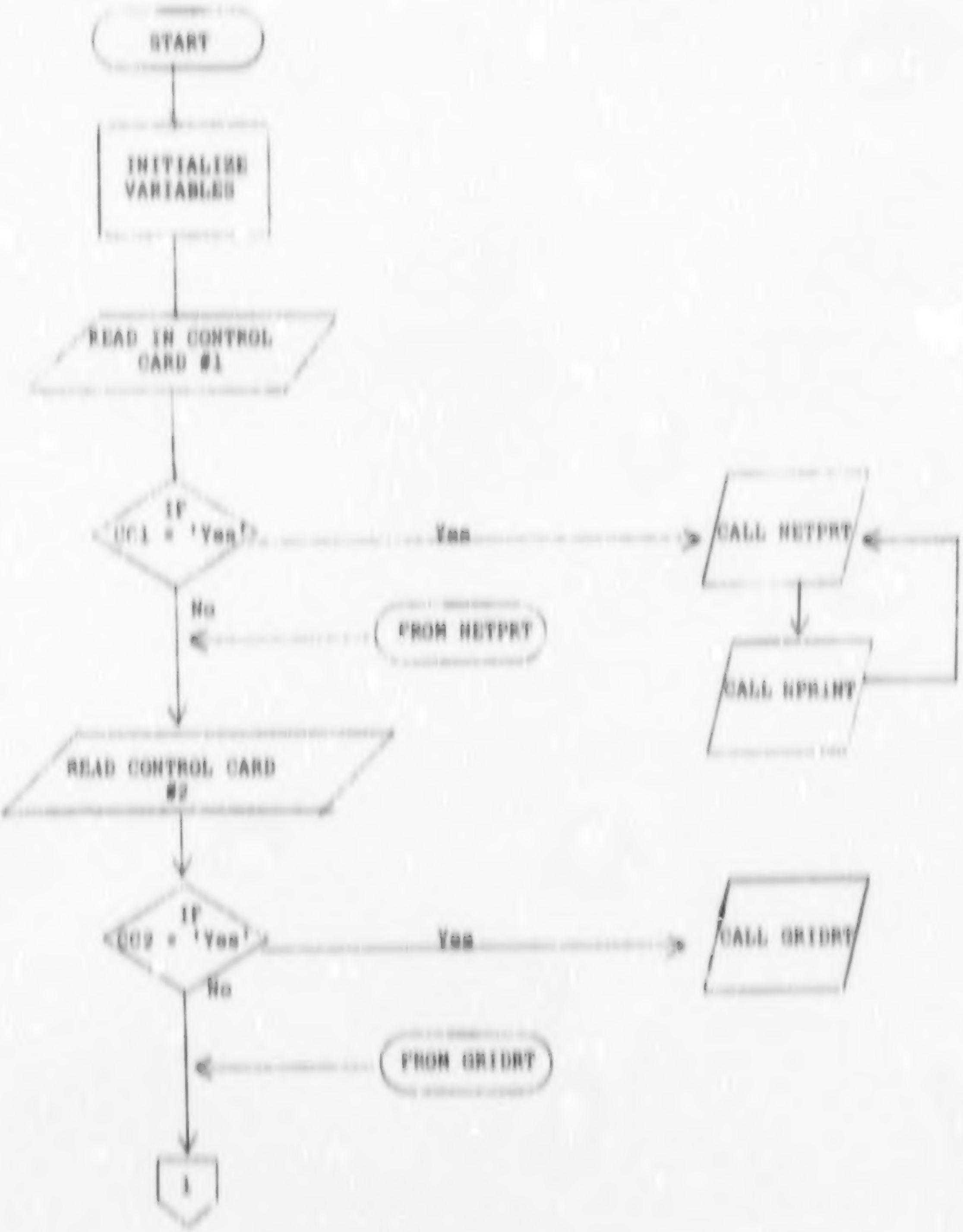
Functional class, special toprgraphy, capacity alterations, sensitive land use, progressive movement, channelization, activity centers, county, and state are all major variables with many component sub-classifications within them. For example, functional class FCLSSC includes not present, freeways, principal arterial, minor arterial, collector, and local streets. Each of these can be tested for individually, or in conjunction with some multiples of one. The user can test for freeway; freeway and principal arterial, freeway, local, and collector, etc. The program also has the ability to not test for any of these by leaving the whole(FCLSSC (J), J = 1,6)section on the control card blank or coded zeros.

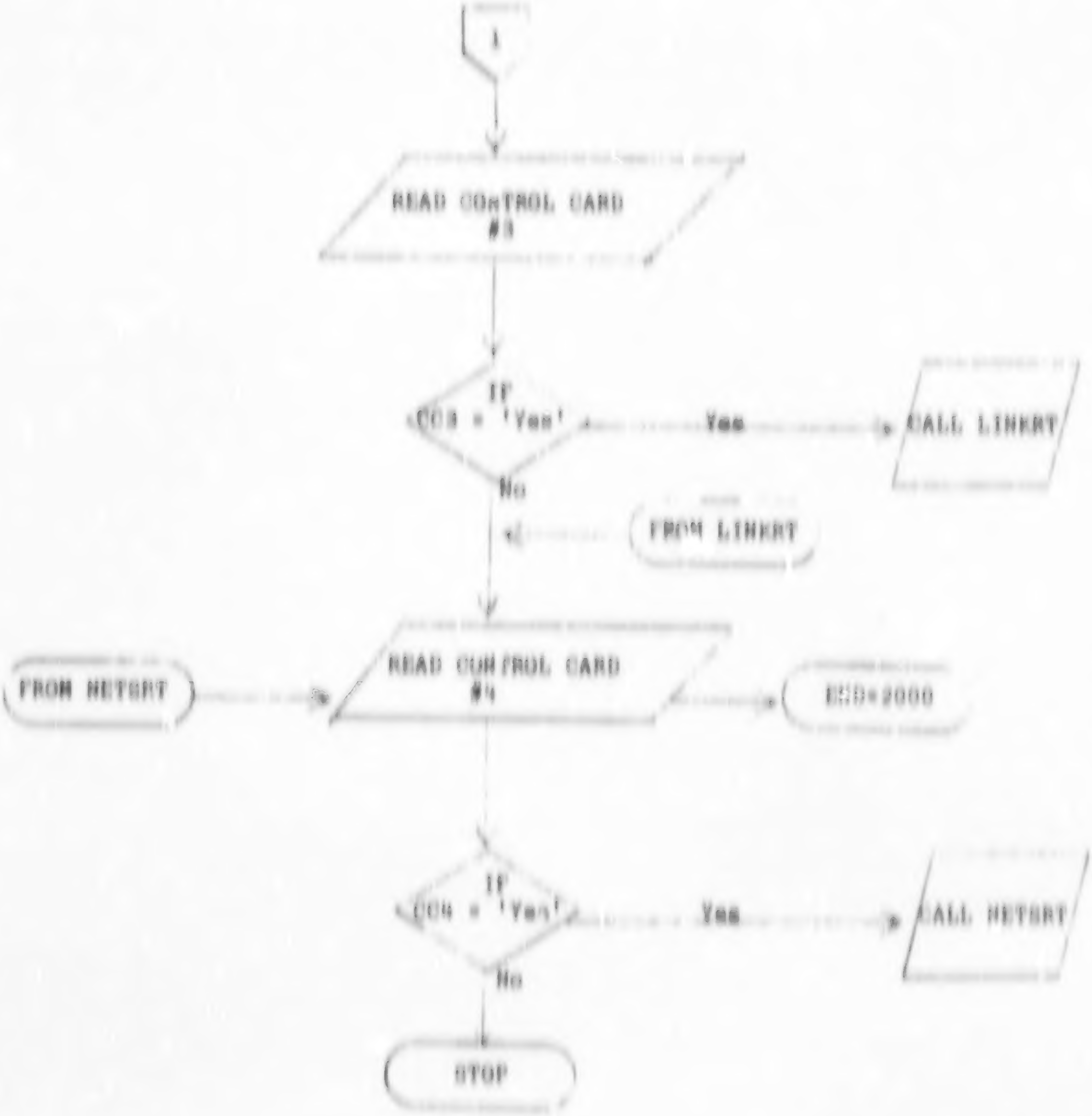
After the final data card is read, the program rewinds the tape or disk file containing the link records (data card input) and the user has the option to read another control card and start the whole procedure over again. When no more control cards are read in and all testing for the previous control card is completed, the subroutine ends and then the program ends.

A copy of the output from this subroutine appears on page 135 The output allows the user to have a written record of the parameters tested for, along with the link number of the link.

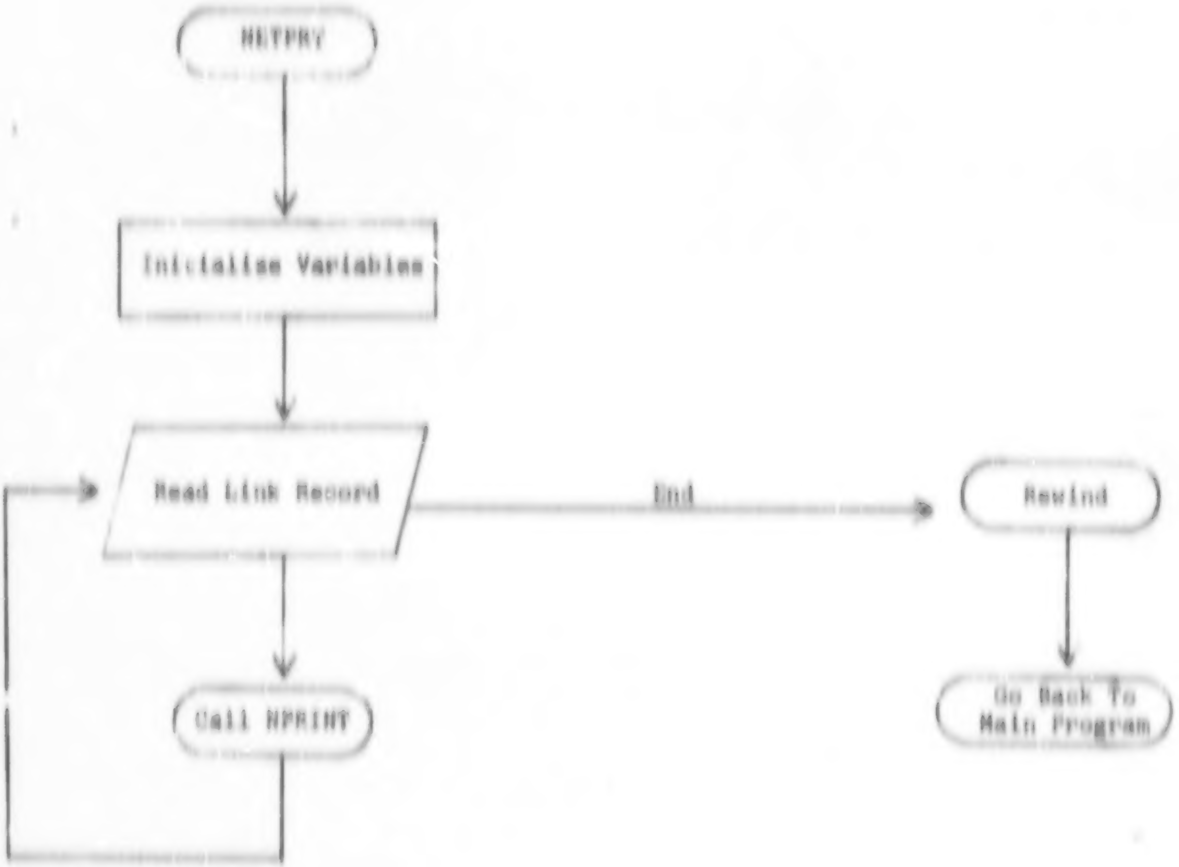
A-2 NETSEN II: PROGRAM FLOW CHART

MAIN

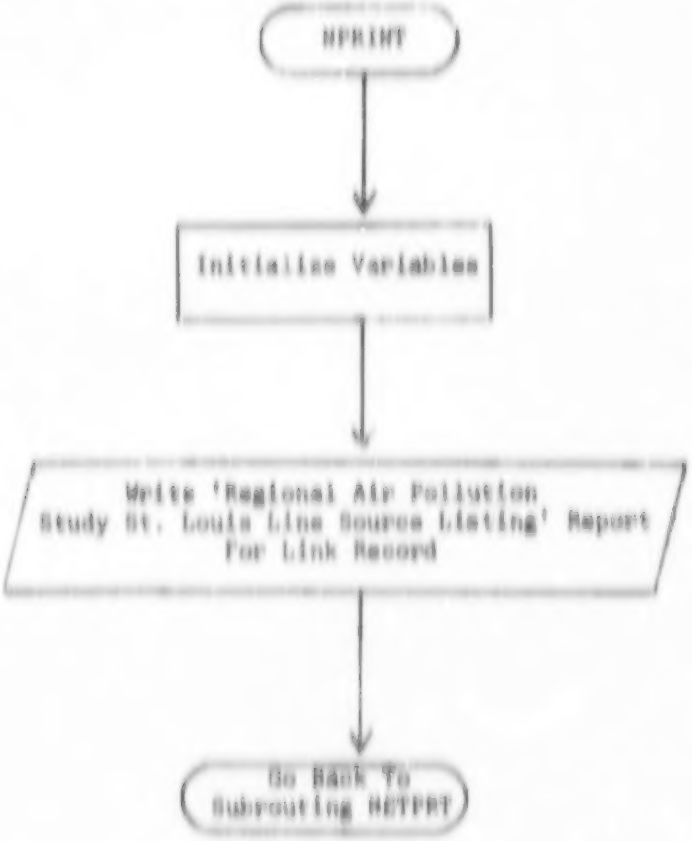

START
INITIALIZE VARIABLES
READ IN CONTROL CARD #1
IF CC1 = 'Yes'
Yes
CALL NETPRT
CALL NPRINT
No
FROM NETPRT
READ CONTROL CARD #2
IF CC2 = 'Yes'
Yes
CALL GRIDRT
No
FROM GRIDRT
1


1
READ CONTROL CARD #3
IF CC3 = 'Yes'
Yes
CALL LINKRT
No
FROM LINKRT
FROM NETSRT
READ CONTROL CARD #4
END=2000
IF CC4 = 'Yes'
Yes
CALL NETSRT
No
STOP

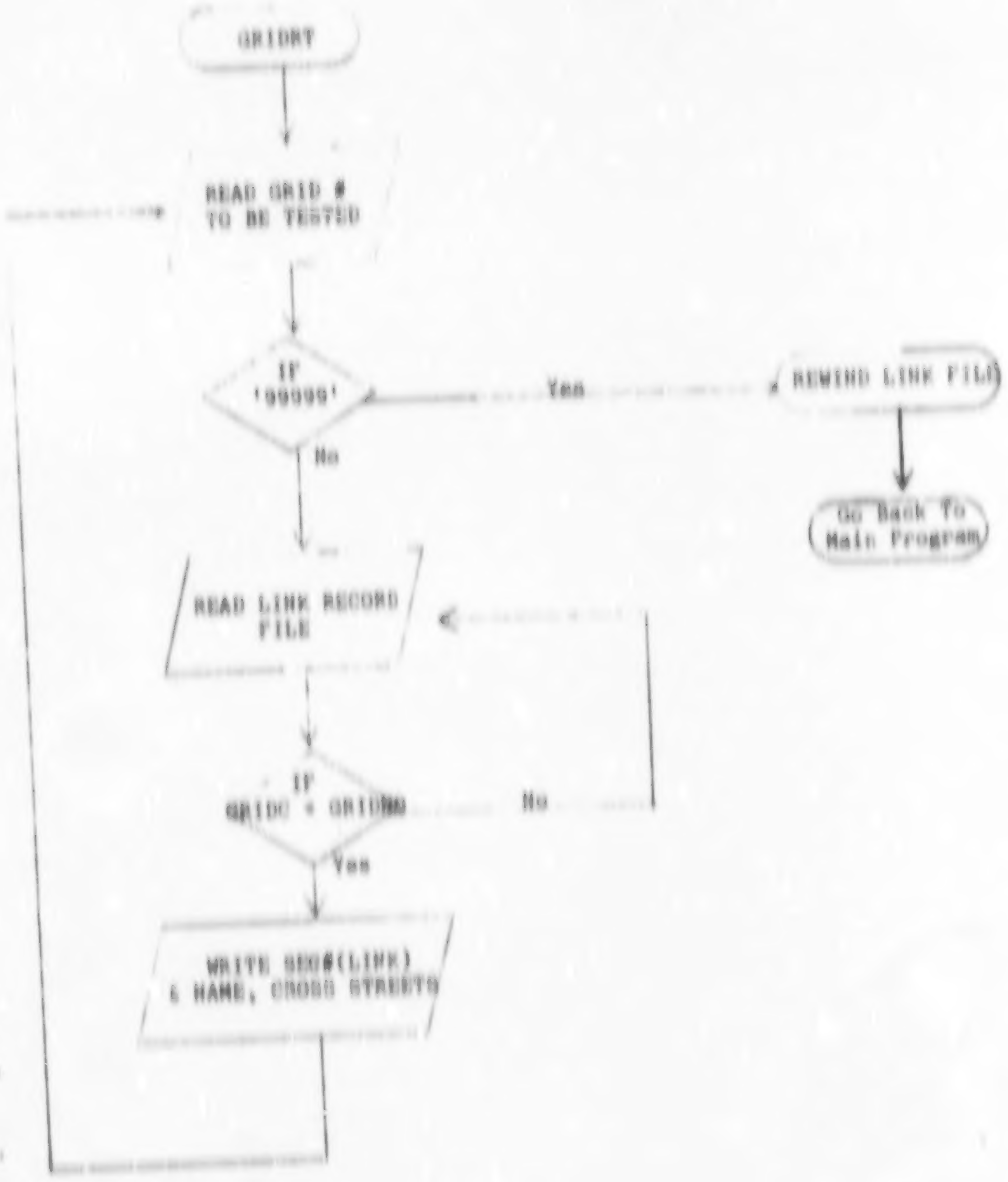
SUBROUTINE NETPRT


NETPRT
Initialise Variables
Read Link Record
End
Rewind
Call NPRINT
Go Back To Main Program

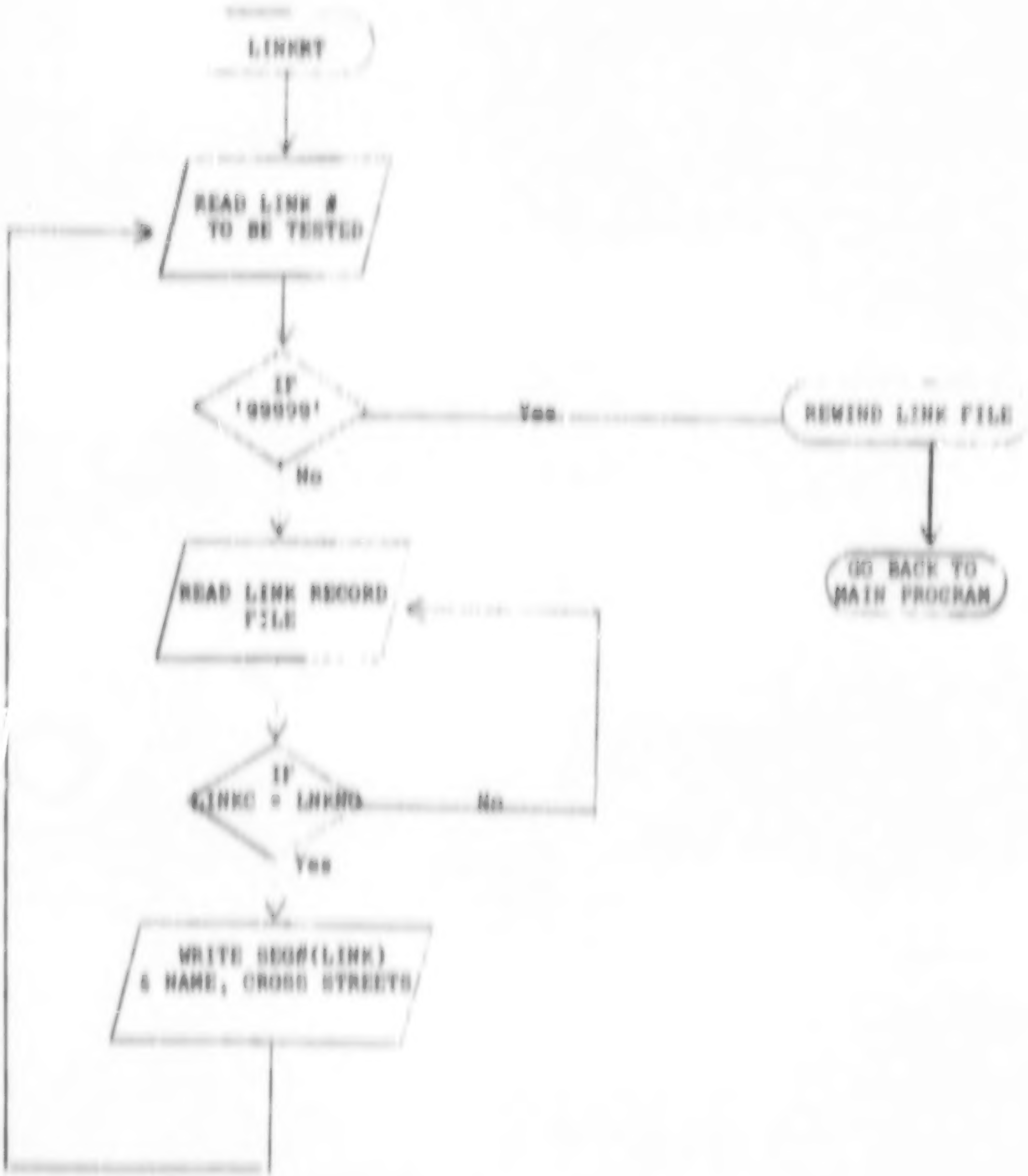
SUBROUTINE HPRINT


HPRINT
Initialize Variables
Write 'Regional Air Pollution Study St. Louis Line Source Listing' Report For Link Record
Go Back To Subrouting NETPRT

SUBROUTINE GRIDRT

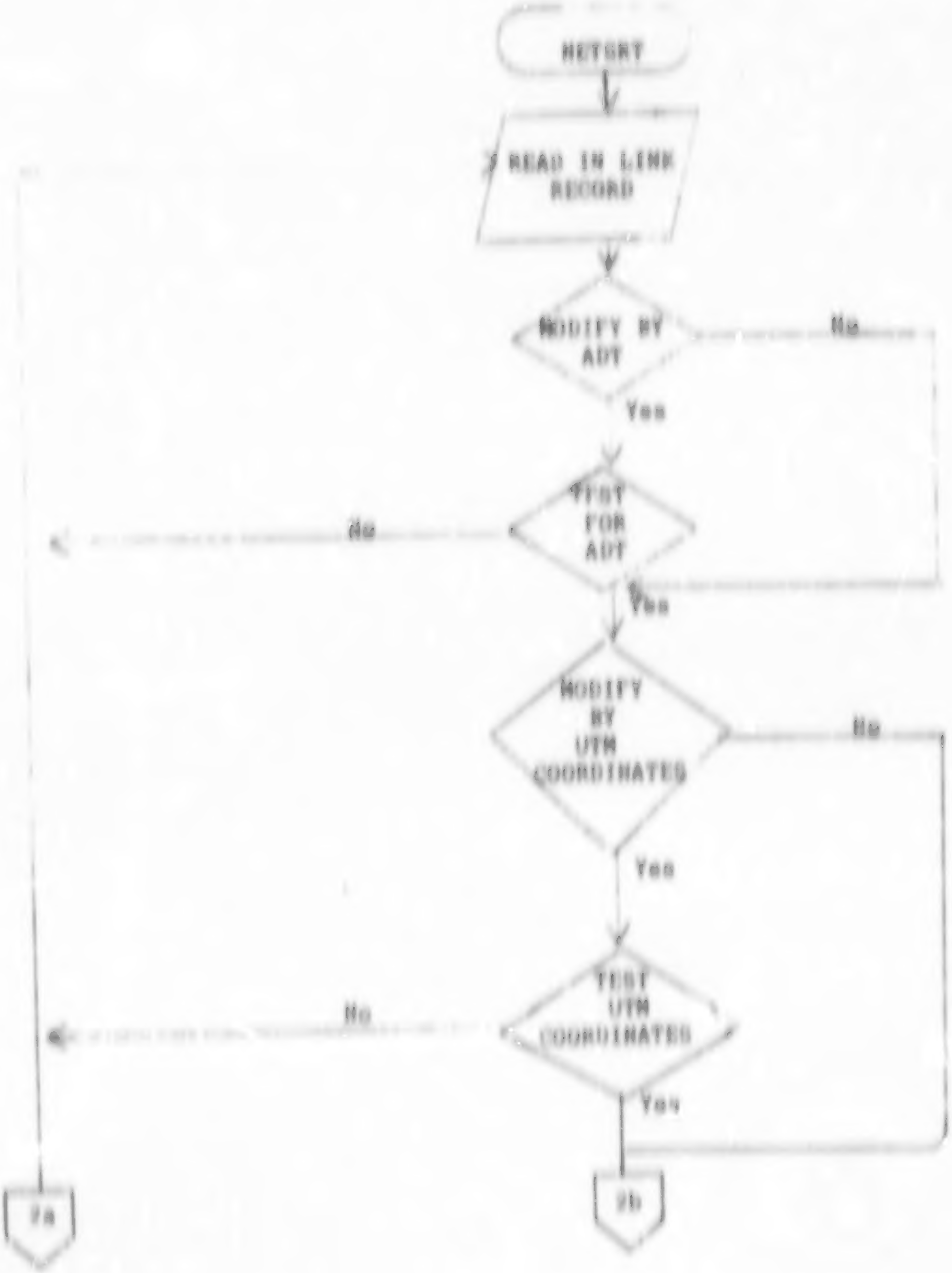

GRIDRT
READ GRID # TO BE TESTED
IF '99999'
Yes
REWIND LINK FILE
Go Back To Main Program
No
READ LINK RECORD FILE
IF GRIDC = GRIDNO
No
Yes
WRITE SEG#(LINK) & NAME, CROSS STREETS

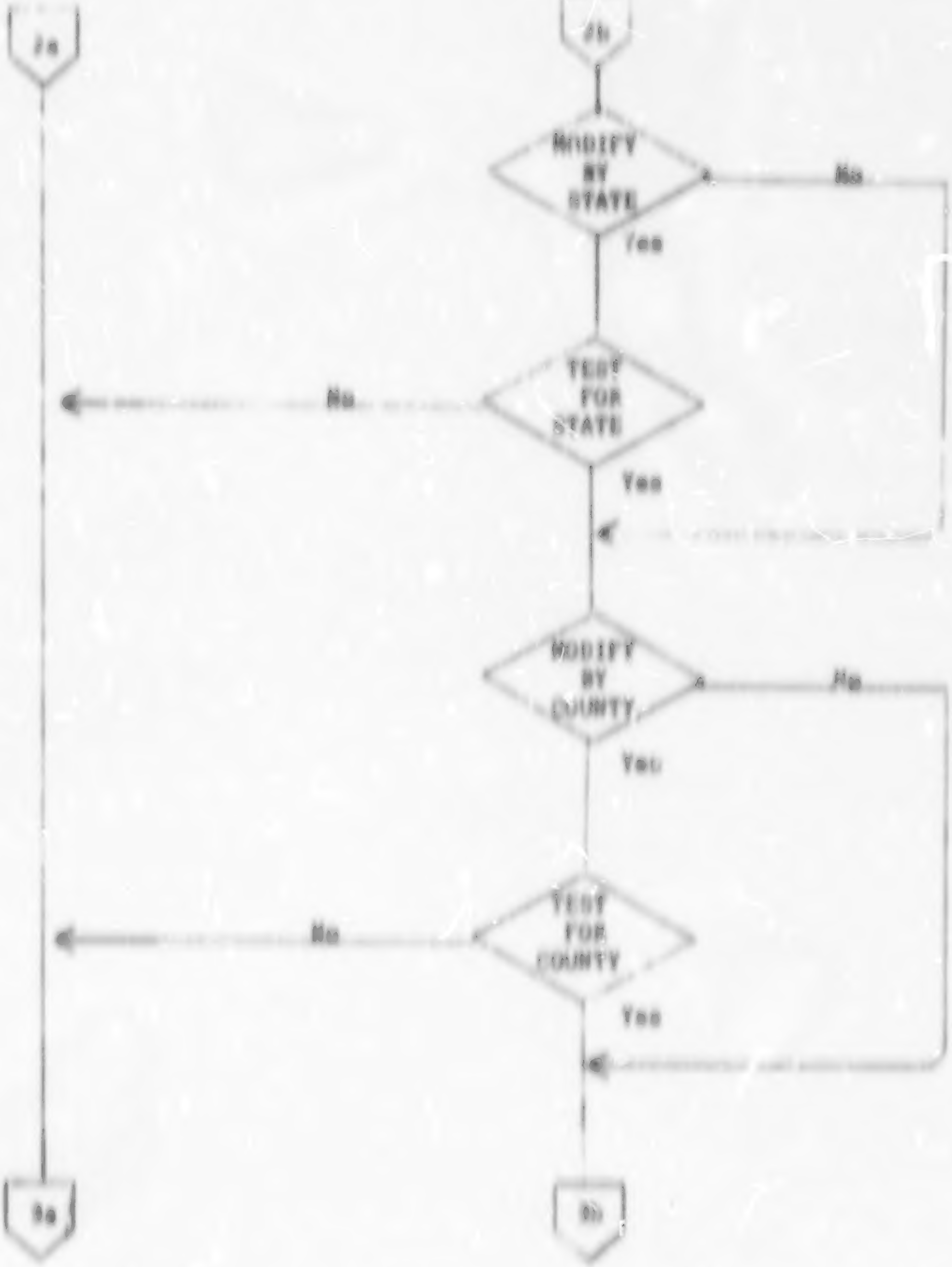
SUBROUTINE LINKRT

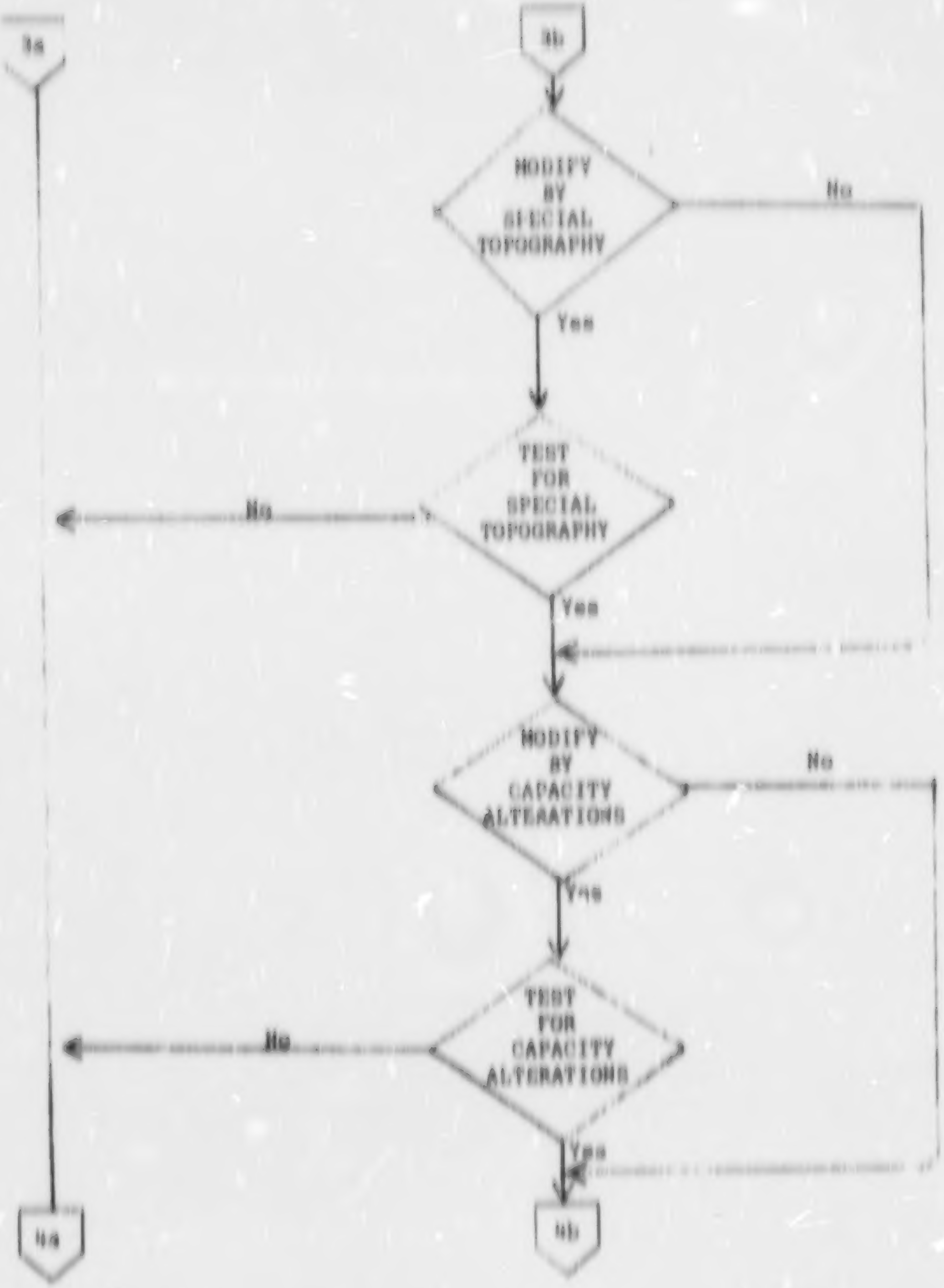

LINKRT
READ LINK #
TO BE TESTED
IF
'99999'
Yes
No
REWIND LINK FILE
GO BACK TO
MAIN PROGRAM
READ LINK RECORD
FILE
IF
LINKC = LNKNO
No
Yes
WRITE SEG#(LINK)
& NAME, CROSS STREETS

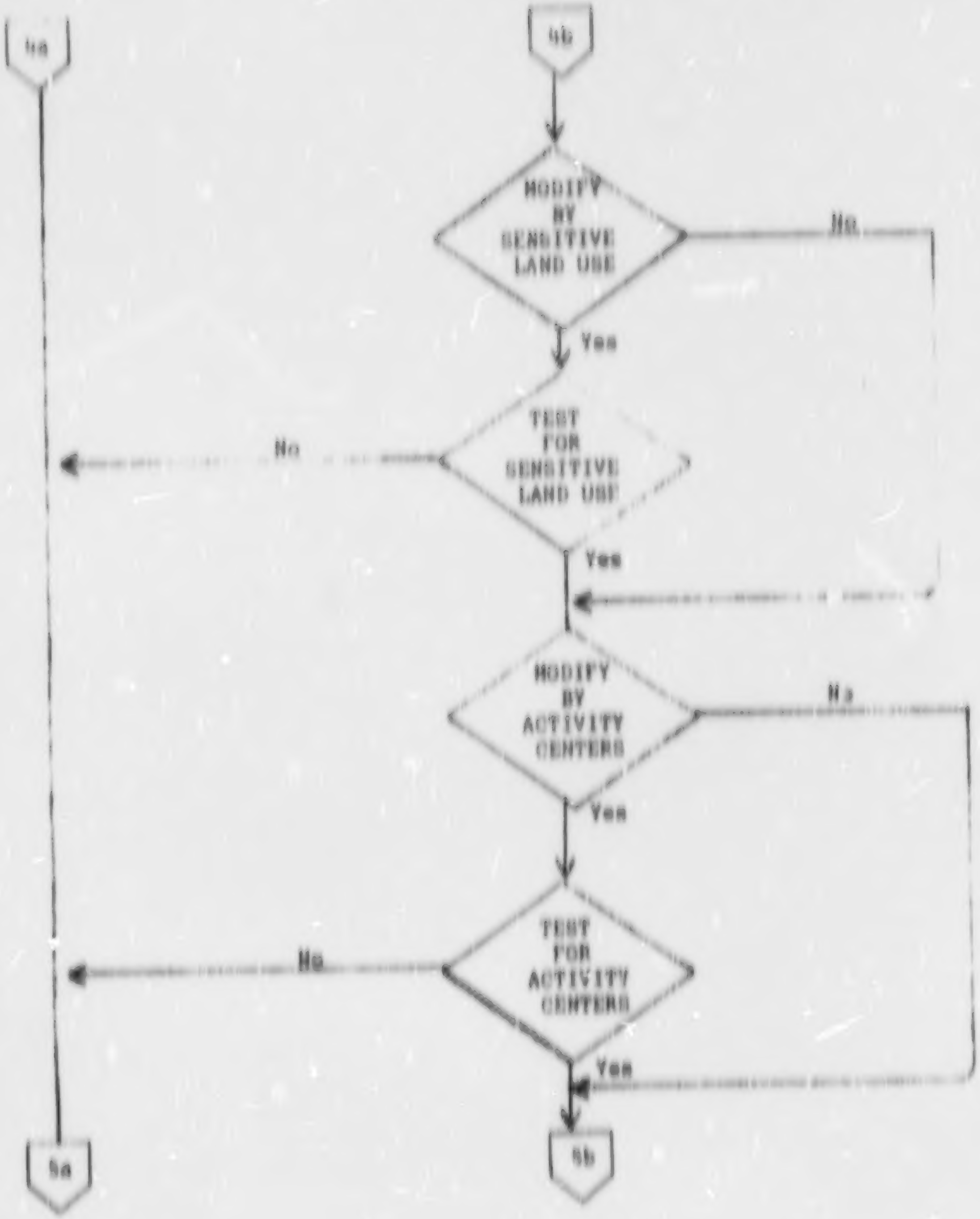
]

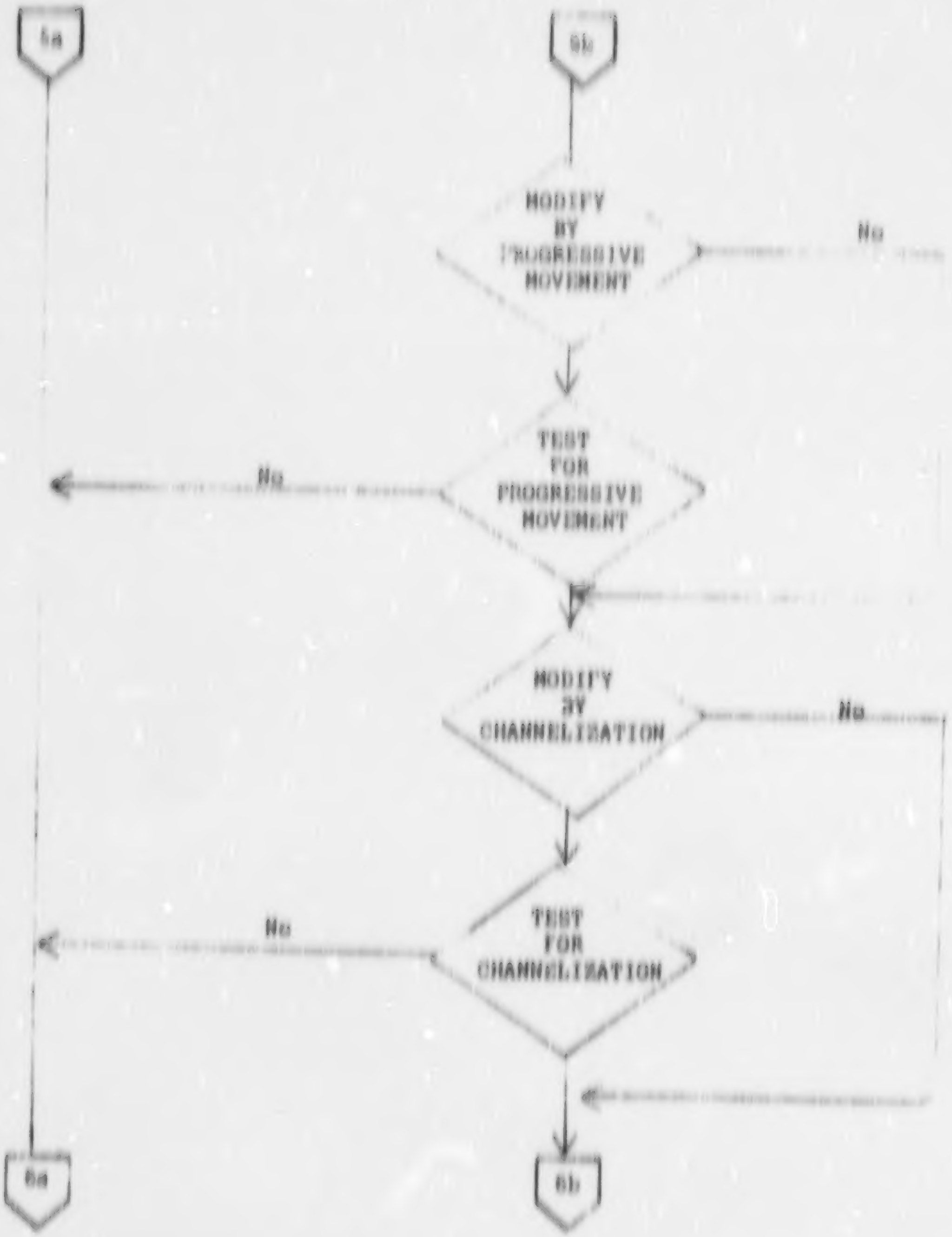
SUBROUTINE NETSRT

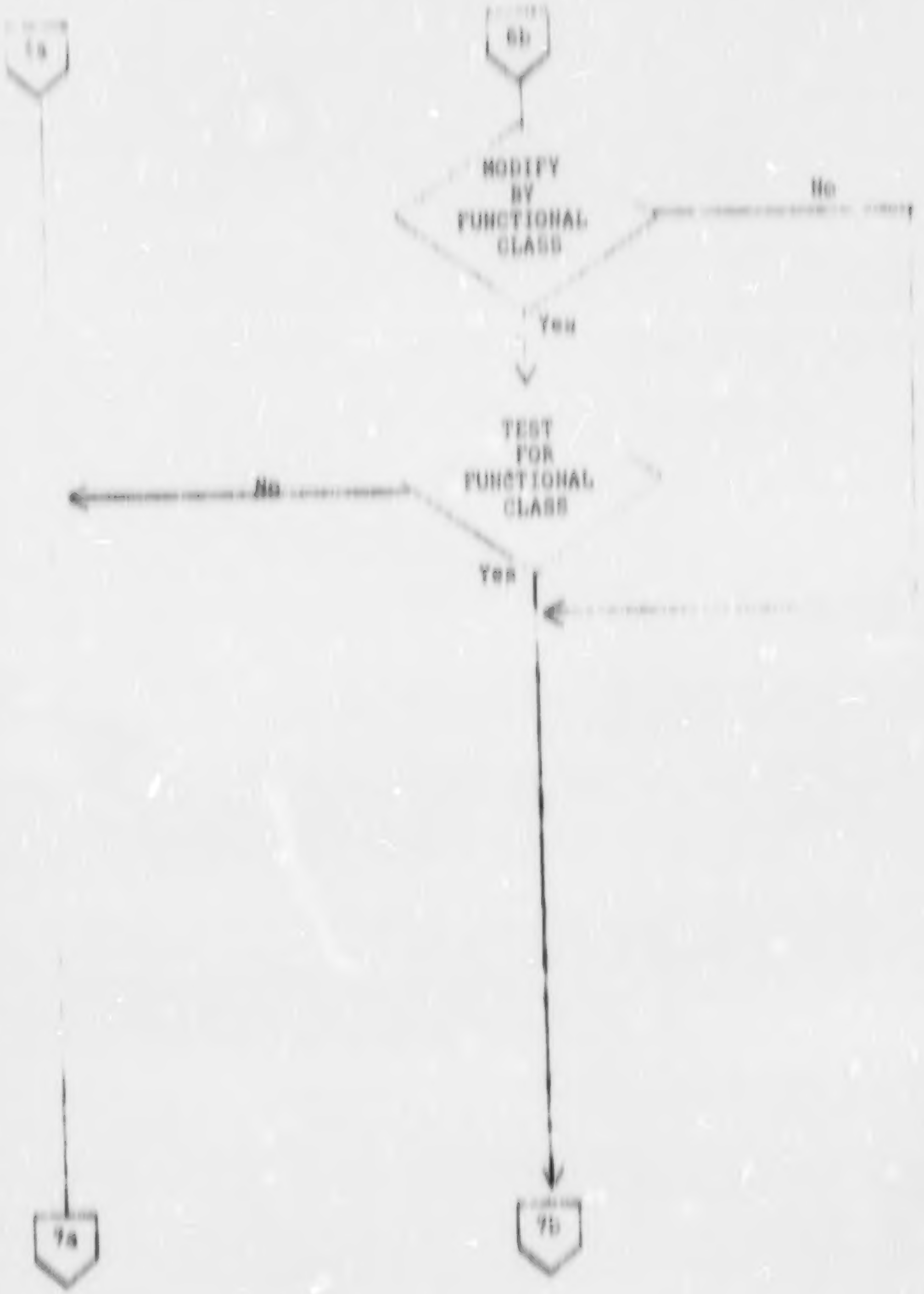

NETSRT
READ IN LINK RECORD
MODIFY BY ADT
No
Yes
TEST FOR ADT
No
Yes
MODIFY BY UTM COORDINATES
No
Yes
TEST UTM COORDINATES
No
Yes
7a
7b

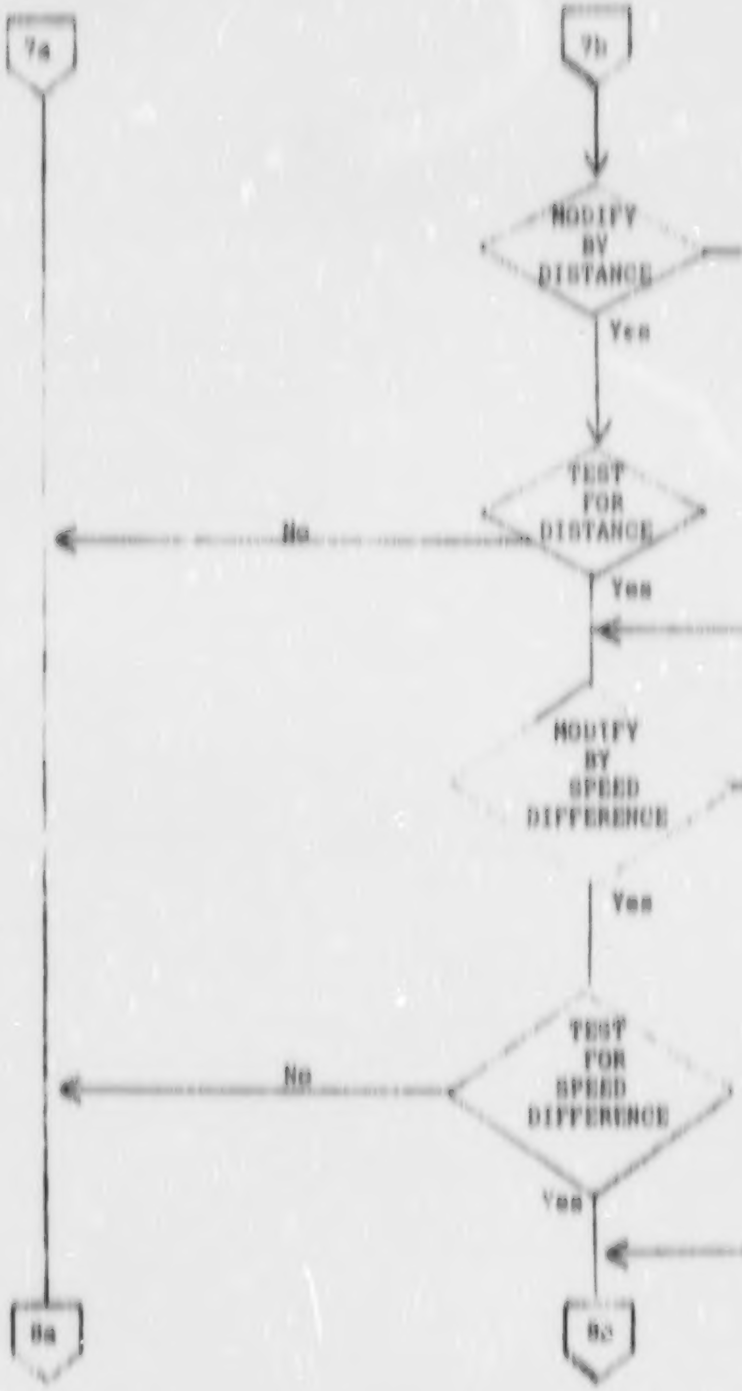

7a
7b
MODIFY BY STATE
No
Yes
TEST FOR STATE
No
Yes
MODIFY BY COUNTY
No
Yes
TEST FOR COUNTY
No
Yes
8a
8b

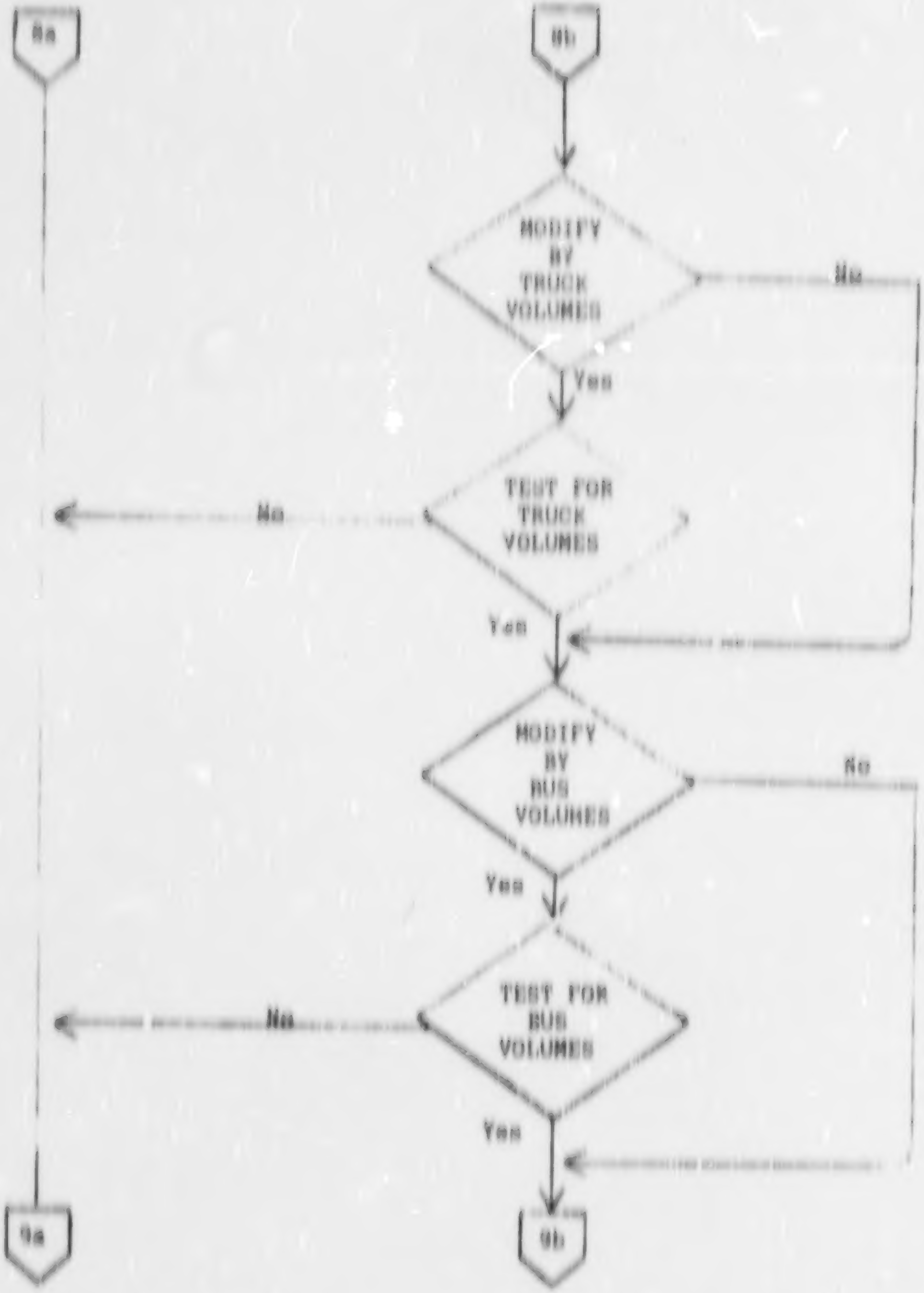

3a
3b
MODIFY BY SPECIAL TOPOGRAPHY
No
Yes
TEST FOR SPECIAL TOPOGRAPHY
No
Yes
MODIFY BY CAPACITY ALTERATIONS
No
Yes
TEST FOR CAPACITY ALTERATIONS
No
Yes
4a
4b

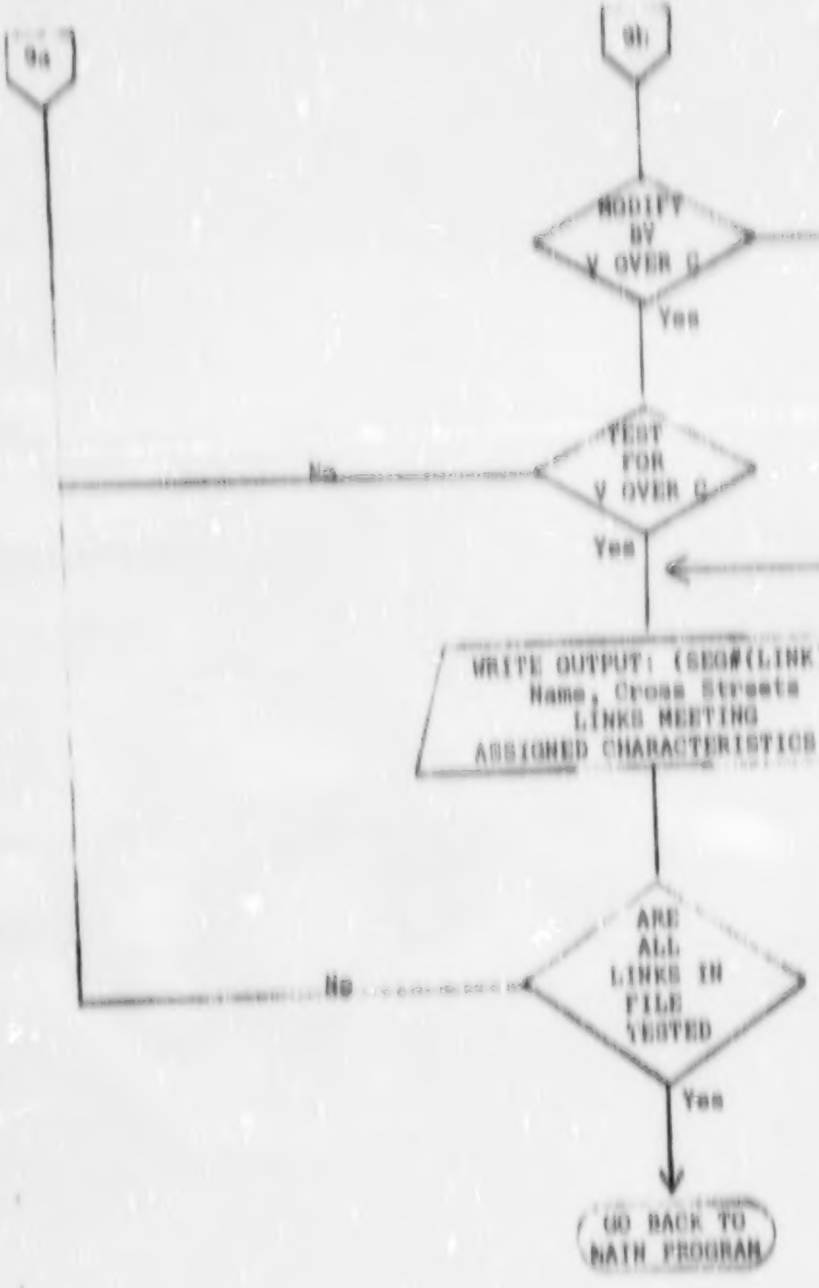

4a
4b
MODIFY BY SENSITIVE LAND USE
No
Yes
TEST FOR SENSITIVE LAND USE
No
Yes
MODIFY BY ACTIVITY CENTERS
No
Yes
TEST FOR ACTIVITY CENTERS
No
Yes
5a
5b


5a
5b
MODIFY BY PROGRESSIVE MOVEMENT
No
TEST FOR PROGRESSIVE MOVEMENT
No
MODIFY BY CHANNELIZATION
No
TEST FOR CHANNELIZATION
No
6a
6b


6b
MODIFY BY FUNCTIONAL CLASS
No
Yes
TEST FOR FUNCTIONAL CLASS
No
Yes
7a
7b


7a
7b
MODIFY BY DISTANCE
No
Yes
TEST FOR DISTANCE
No
Yes
MODIFY BY SPEED DIFFERENCE
No
Yes
TEST FOR SPEED DIFFERENCE
No
Yes
8a
8b


8a
8b
MODIFY BY TRUCK VOLUMES
No
Yes
TEST FOR TRUCK VOLUMES
No
Yes
MODIFY BY BUS VOLUMES
No
Yes
TEST FOR BUS VOLUMES
No
Yes
9a
9b


9a
9b
MODIFY BY V OVER C
No
Yes
TEST FOR V OVER C
No
Yes
WRITE OUTPUT: (SEG#(LINK)), Name, Cross Streets LINKS MEETING ASSIGNED CHARACTERISTICS
ARE ALL LINKS IN FILE TESTED
No
Yes
GO BACK TO MAIN PROGRAM

A-3 NETSEN II: INPUT DATA CARDS FORMAT

EPA II: NETSEN II DATA CARDS

DATA CARD #1

Variable Name		Columns
ANODE	I5	1-5
LEGA	I1	6
BNODE	I5	7-11
LEGB	I1	12
UTMAX	F5.1	13-17
UTMAY	F5.1	18-22
UTMBX	F5.1	23-27
UTMBY	F5.1	28-32
STATEN	I1	33
CTYN	I2	34-35
GRIDNO	I5	36-40
RTNAME (J), J=1,5	5A4	41-60
CRSSTA (J), J=1,5	5A4	61-80

EPA II: HUTSEH II DATA CARDS

DATA CARD #2

Variable Name		Columns
CRSPTB (J), J=1,5	5A4	1-20
LHFNO	I6	21-26
LDIS	F4.2	27-30
ADT	I6	31-36
PKHRP	F2.2	37-38
AVDIR	I2	39-40
AMAXHR	I4	41-44
AVTIME	I1	45
AVVOL	I4	46-49
BVDIR	I2	50-51
BMAXHR	I4	52-55
BVTIME	I1	56
BVVOL	I4	57-60
	4X	61-64
	2X	65-66
ADASPD	I2	67-68
AMPKSP	I2	69-70
AMDIR	I1	71
PMPKSP	I2	72-73
PMDIR	I1	74
	6X	75-80

EPA II: NETGEN II DATA CARDS

DATA CARD #3

Variable Name		Columns
ACPACT	I5	1-5
BCPACT	I5	6-10
TRUKVL	I4	11-14
TRUKPC	F2.2	15-16
BUSVL	I4	17-20
BUSPC	F2.2	21-22
SPTOPL	I1	23
CPALTL	I1	24
SENLUL	I1	25
ACTCHT	I1	26
PROHOL	I1	27
CHANAL	I1	28
FCLSSL	I1	29

A-4 NETSEN II: INPUT DATA CARD EXPLANATION

CODING; DATA CARD; NETSEN II

Variable Name	
ANODE	The A node number is five characters in length, an integer variable and has values ranging from 1 to 99999.
LEGA	The A node leg number is one character in length, an integer variable and has values from 0 to 3. The value of 0 is equal to an intersection leg in a northern direction, 1 is equal to east, 2 is equal to south, and 3 equals west.
BNODE	The B node number is five characters in length, an integer variable and has values ranging from 1 to 99999.
LEGB	The B node leg number has the same values as variable LEGA.
UTMAX	The longitudinal Universal Transverse Mercator projection for the A node. UTMAX is a real variable having values ranging from 0.0 to 9999.9.
UTMAY	The latitudinal Universal Transverse Mercator projection for the A node. UTMAY is a real variable having values ranging from 0.0 to 9999.9.
UTMBX	The longitudinal Universal Transverse Mercator projection for the B node. UTMBX is a real variable having values ranging from 0.0 to 9999.9.
UTMBY	The latitudinal Universal Transverse Mercator projection for the B node. UTMBY is a real variable having values ranging from 0.0 to 9999.9.
STATEN	The State of the U.S. in which the link resides. The value of 0 is unknown, 1 represents Missouri and 2 represents Illinois.

CTYN	The county in which the link resides. CTYN is a two digit integer variable. The value of 0 is unknown, 1 is St. Louis City 2 is St. Louis County 3 is St. Charles County 4 is Jefferson County 5 is Frarklin County 6 is Bond County 7 is Clinton County 8 is Madison County 9 is Monroe County 10 is Randolph County 11 is St. Clair County 12 is Washington County
GRIDNO	GRIDNO represents the grid number which the link resides. GRIDNO is a five digit integer variable with values from 0 to 99999.
RTNAME (J)	The Route name is 20 (5A4) characters in length and is left justified.
CRSSTA (J)	The cross street or break point at node A is 20 (5A4) characters in length and is left justified.
CRSSTB (J)	The cross street or breakpoint at node B is 20 (5A4) characters in length and is left justified.
LNKNO	The link number is a 6 character integer variable and has values ranging from 0 to 999999.
LDIS	Is a four digit real variable representing the distance from A node to B node. LDIS ranges in value from 0.0 to 99.99.
ADT	The Average Daily Traffic Volume for the link. It is six characters in length, an integer variable and has values ranging from 1 to 999999.

PKHRP	The percent of the Average Daily Traffic (ADT) that represents the peak hour traffic. PKHRP is a real variable ranging in values of .00 to .99.
AVDIR	The direction of the peak hour and the type of facility (one-way, two-way, reversible). It is two characters in length, an integer variable and the first digit concerns the type facility, one-way is coded as a 1, two-way is 2, reversible is 3. The second digit refers to direction of this facility, northbound is coded as 1, eastbound equals 3, southbound equals 2, westbound equals 4, and both directions equals 5.
AMAXHR	The beginning of the peak hour for the link. It is four characters in length, an integer value, and the first two characters correspond to the hours of the day and the last two correspond to the minutes.
AVTIME	This corresponds to the AM or PM of the day. AM is coded as a 1, PM is coded as a 2. AVTIME is a one digit integer variable.
AVVOL	This variable is the peak hour volume for the link. AVVOL is a four digit integer variable with values from 0 to 9999.

AVDIR, AMAXHR, AVTIME, AVVOL all correspond to BVDIR, BMAXHR, BVTIME, BVVOL. with the latter being in the opposite direction.

BVDIR	Two character integer variable. The first digit corresponds to the type of facility, one-way is coded as a 1, two-way is 2, reversible is 3. The second digit refers to direction of the facility, northbound is coded as 1, southbound equals 2, eastbound 3, westbound 4, and both directions equals 5.
BMAXHR	The beginning of the other peak hour for the link. It is a four character integer variable and the first two digits are hours and the last two digits minutes.
BVTIME	This corresponds to the AM or PM time of the peak.

	AM is coded as a 1, PM is coded as a 2. BVTIME is a one digit integer variable.
BVVOL	This is a four digit integer variable corresponding to the peak hour volume for the link under consideration. The range is from 0 to 9999.
ADASPD	Average daily speed for the link. It is an integer variable two digits long and a range from 0 to 99 mph.
AMPKSP	AM peak speed for the link. Integer variable two digits long and a range from 0 to 99.
AMDIR	The direction for the AM peak speed. A northbound direction is coded as a 1, southbound 2, eastbound 3, and westbound 4. A one digit integer variable.
PMPKSP	PM peak speed for the link. Integer variable two digits long and ranges from 0 to 99.
PMDIR	The direction for the PM peak speed. A northbound direction is coded as a 1, southbound 2, eastbound 3, and westbound 4. A one digit integer variable.
ACPACT	The capacity from the A node to the B node. ACPACT is a five digit integer variable with a range from 0 to 99999.
BCPACT	The capacity from the A node to the B node. BCPACT is a five digit integer variable with a range from 0 to 99999.
TRUKVL	The daily truck volume for the link under consideration. TRUKVL is a four digit integer variable with a range from 0 to 9999.

TRUKPC	Is truck volume expressed a a percent of ADT. TRUKPC is a real variable having values ranging from .00 to .99.
BUSVL	The daily bus volume for the link under consideration. BUSVL is a four digit integer variable with a range from 0 to 9999.
BUSPC	Is bus volume expressed as a percent of ADT. BUSPC is a real variable having values ranging from .00 to .99.
SPTOPL	Is a one digit integer variable which represents special topography conditions, values are from 0 to 4 corresponding to: 0 equals not present, 1 equals deep cut, 2 equals high fill, 3 equals street canyon, and 4 equals rolling topography.
CPALTL	Is a one digit integer variable which represents capacity alterations. Values range from 0 to 5 with 0 equaling not present, 1 equals complex interchanges, 2 equals lane reduction, 3 equals bottleneck segment, 4 equals 2 and 3, 5 equals 1 and 3.
SENLUL	Is a one digit integer variable which represents sensitive land uses. Values range from 0 to 7 with 0 equaling not present, 1 equaling commercial development- 2 equaling residential development, 3 equaling recreation, 4 equaling hospitals, 5 universities or colleges, 6 airports, and 7 multi-family. These sensitive land uses are medium to high densities with regard to generation of critical traffic volumes.
ACTCNT	Is a one digit integer variable which represents activity centers. Values range from 0 to 5 with 0 equaling not present, 1 Central Business District, 2 fringe area, 3 outlying business district, 4 residential area and 5 rural area.

PROMOL	is a one digit integer variable which represents progressive movement within the link. Values range from 0 to 4, with 0 equaling not present, 1 pre-timed progressive, 2 interconnected progressive signal, 3 one-way street flow without signal progression, 4 one-way street flow with signal progression.
CHANAL	is a one digit integer variable which represents if the link is channelized or not. Values range from 0 to 1 with 0 channelized, and 1 not channelized.
FCLSSL	is a one digit integer variable which represents the functional classification for the link under consideration. Values range from 0 to 5, with 0 equaling not present, 1 equaling freeway, 2 principle arterial, 3 minor arterial, 4 collector, 5 local.

A-5 NETSEN II: SAMPLE DATA CODING SHEET

Card 1

ANODE	1 2 3 4 5
LEGA	6
BNODE	7 8 9 10 11
LEGB	12
UTMAX	13 14 15 16 17
UTMAY	18 19 20 21 22
UTMBX	23 24 25 26 27
UTMBY	28 29 30 31 32
STATEN	33
CTYN	34 35
GRIDNO	36 37 38 39 40
STNAME(J)	41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
CRSSTA(J)	61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

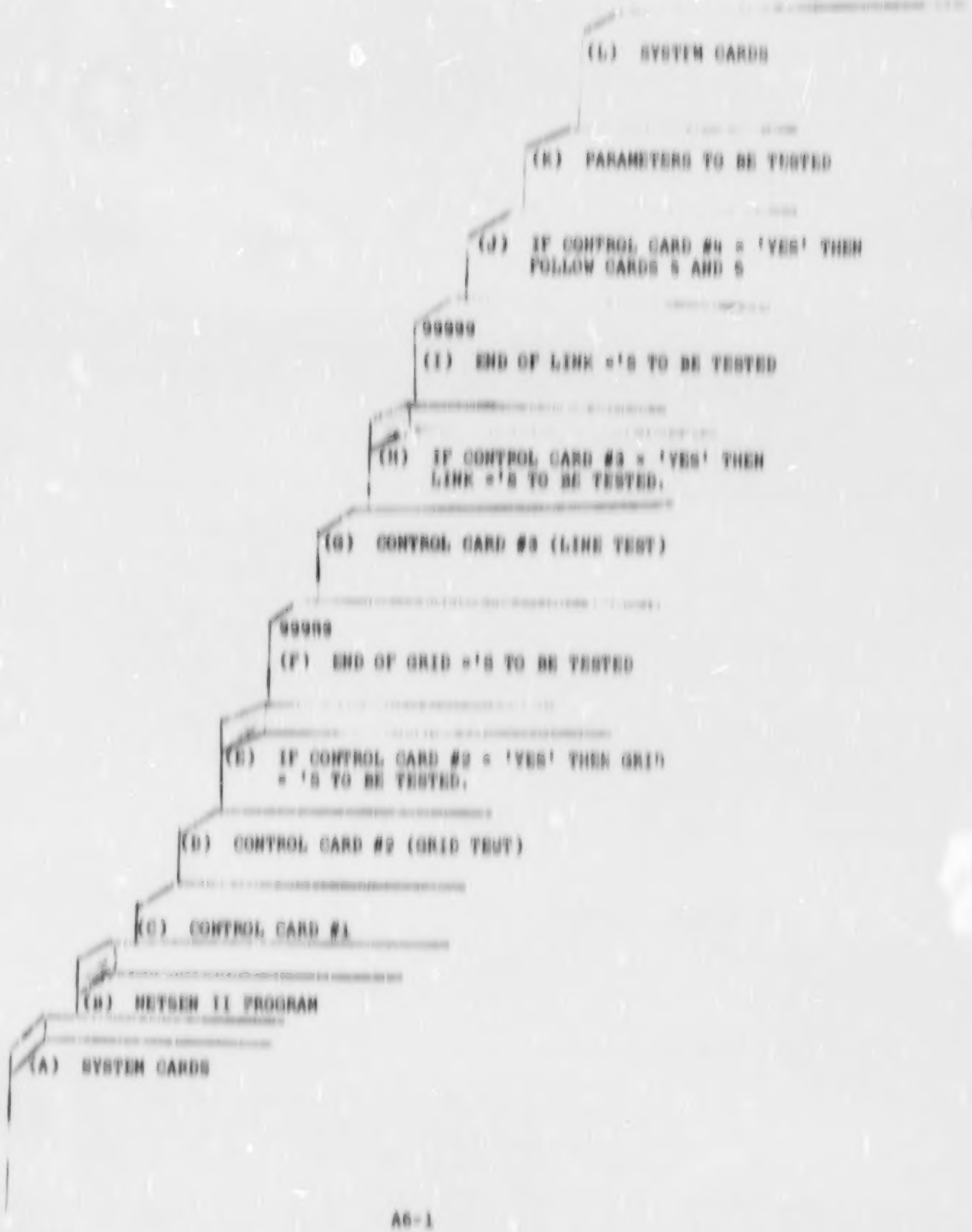
Card 2

CRSSTB(J)	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 1
LNENO	21 22 23 24 25 26
LDIS	27 28 29 30
ADT	31 32 33 34 35 36
PKHRF	37 38
AVDIR	39 40
AMAXHR	41 42 43 44
AVTIME	45
AVVOL	46 47 48 49
BVDIR	50 51
BMAXHR	52 53 54 55
BVTIME	56
BVVOL	57 58 59 60
	61 62 63 64
	65 66
ADASPD	67 68
AMPKSP	69 70
AMDIR	71
PMPKSP	72 73
PMDIR	74
	75 76 77 78 79 80

Card 3

ACPALT	1 2 3 4 5
BCPALT	6 7 8 9 10
TRUKVL	11 12 13 14
TRUKPC	15 16
BUSVL	17 18 19 20
BUSPC	21 22
SPTOPL	23
CPALTL	24
SENLUL	25
ACTCNT	26
PROMOL	27
CHANAL	28
TCLSEL	29

A-6 NETSEN II: DECK STRUCTURE


(L) SYSTEM CARDS
(K) PARAMETERS TO BE TESTED
(J) IF CONTROL CARD #4 = 'YES' THEN FOLLOW CARDS 5 AND 6
99999
(I) END OF LINK #'S TO BE TESTED
(H) IF CONTROL CARD #3 = 'YES' THEN LINK #'S TO BE TESTED.
(G) CONTROL CARD #3 (LINE TEST)
99999
(F) END OF GRID #'S TO BE TESTED
(E) IF CONTROL CARD #2 = 'YES' THEN GRID #'S TO BE TESTED.
(D) CONTROL CARD #2 (GRID TEST)
(C) CONTROL CARD #1
(B) NETSEN II PROGRAM
(A) SYSTEM CARDS

A-7 NETGEN II: INPUT CONTROL CARD FORMATS

NETGEN II

Control Card #1

Variable Name		Columns
CC1	A3	1-3

Control Card #2

Variable Name		Columns
CC2	A3	1-3
(If 'YES' then the following, otherwise go to Control CArd #3)		
GRIDTH	I5	1-5

Control Card #3

Variable Name		Columns
CC3	A3	1-3
(If 'YES' then the following, otherwise go to Control Card #4)		
LINKTH	I5	1-5
FORM	A3	6-8

Control Card #4

Variable Name		Columns
CC4	A3	1-3

(If 'YES' then go to CArds #5 and 6, otherwise end of program)

NETGEN II: CONTROL CARD FORMATS

CONTROL CARD # 5

Variable Name		Columns
	3X	1-3
ADTLW	I6	4-9
ADTHI	I6	10-15
XSUB1	F5.1	16-20
XSUB2	F5.1	21-25
YSUB1	F5.1	26-30
YSUB2	F5.1	31-35
STATEC (1)	I1	36
STATEC (2)	I1	37
STATEC (3)	I1	38
CTYNO (1)	I1	39

NETSEN II: CONTROL CARD FORMATS

CONTROL CARD #5 CONTINUED

Variable Name		Columns
CTYNO (2)	I1	40
CTYNO (3)	I1	41
CTYNO (4)	I1	42
CTYNO (5)	I1	43
CTYNO (6)	I1	44
CTYNO (7)	I1	45
CTYNO (8)	I1	46
CTYNO (9)	I1	47
CTYNO (10)	I1	48
CTYNO (11)	I1	49
CTYNO (12)	I1	50
CTYNO (13)	I1	51

NETSEN II: CONTROL CARD FORMATS

CONTROL CARD # 5 CONTINUED

Variable Name		Columns
SPTOPC (1)	I1	52
SPTOPC (2)	I1	53
SPTOPC (3)	I1	54
SPTOPC (4)	I1	55
SPTOPC (5)	I1	56
CPALTC (1)	I1	57
CPALTC (2)	I1	58
CPALTC (3)	I1	59
CPALTC (4)	I1	60
CPALTC (5)	I1	61
CPALTC (6)	I1	62
SENLUC (1)	I1	63
SENLUC (2)	I1	64

NETGEN II: CONTROL CARD FORMATS

CONTROL CARD # 6 CONTINUED

Variable Name		Columns
SENLUC (3)	I1	65
SENLUC (4)	I1	66
SENLUC (5)	I1	67
SENLUC (6)	I1	68
SENLUC (7)	I1	69
SENLUC (8)	I1	70
ACTONC (1)	I1	71
ACTONC (2)	I1	72
ACTONC (3)	I1	73
ACTONC (4)	I1	74
ACTONC (5)	I1	75
ACTONC (6)	I1	76
	4X	77-80

NETSEN II: CONTROL CARD FORMATS

CONTROL CARD # 6

Variable Name		Columns
PROMOC (1)	I1	1
PROMOC (2)	I1	2
PROMOC (3)	I1	3
PROMOC (4)	I1	4
PROMOC (5)	I1	5
CHANAC (1)	I1	6
CHANAC (2)	I1	7
FCLSSC (1)	I1	8
FCLSSC (2)	I1	9
FCLSSC (3)	I1	10
FCLSSC (4)	I1	11
FCLSSC (5)	I1	12
FCLSSC (6)	I1	13

NETSEN II: CONTROL CARD FORMATS

CONTROL CARD #6 CONTINUED

Variable Name		Columns
LDISH	F4.2	14-17
LDISL	F4.2	18-21
PKSPDH	I2	22-23
PKSPDL	I2	24-25
TRKVHI	I4	26-29
TRKVLW	I4	30-33
BUSHI	I3	34-36
BUSLW	I3	37-39
VOCHI	F3.2	40-42
VOCLW	F3.2	43-45

A-8 NETSEN II: INPUT CONTROL CARD EXPLANATIONS

NETSEN II

Control Card #1

CC1 Is a three character variable with a value of 'YES' or 'NOƀ'. This control card if the value is 'YES' activates subroutine NETPRT which prints a copy of the roadway inventory file in network manual form. (See pg 127 for example) If the roadway inventory file is not to be printed then 'NOƀ' should be placed in the first three columns of the first control card.

Control Card #2

CC2 Is a three character variable with a value of 'YES' or 'NOƀ'. This second control card if the value is 'YES' activates subroutine GRIDRT which tests for a certain grid or set of grids. If a grid number is to be tested for, the grid number should be coded on a separate computer card in its first five columns and should be right justified. If more than one grid is to be tested, the grid numbers should be placed in ascending order on separate cards. At the end of the set of cards to be tested, a card with a '99999' in the first five columns should be entered. Any other values other than 'YES' will not activate the subroutine and the program will move to another control card.

Control Card #3

CC3 Is a three character variable with a value of 'YES' or 'NOƀ'. This third control card if the value is 'YES' activates subroutine LINKRT which tests for a certain link or set of links. If a link number is to be tested for, the link number should be coded on a separate computer card in its first five columns and should be right justified. If more than one link is to be tested, the link numbers should be placed in ascending order on separate cards. If the user wishes the output of the link routine to be of the format of the line source manual output, a 'YES' should be coded in columns 6, 7, and 8 of the card following the link number. At the end of the set of cards to be tested, a card with a '99999' in the first five columns should be entered. Any other values other than 'YES' will not activate the subroutine and the program will move to the fourth control card.

Control Card #4

CC4 Is a three character variable with a value of 'YES' or 'NOƀ'. This fourth control card if the value is 'YES' activates subroutine NETSRT which does the network sort. Following the card with the 'YES' are cards five and six which may be repeated if the user wishes. These cards contain the variables which the program will sort for and are explainud on the following pages. If the user does not wish to test for a specific variable he leaves it blank. If the routine is not to be activated a 'NON' should be coded in the first three columns and the routine will be skipped and the program will end.

CODING: CONTROL CARDS #5 AND 6, NETSEN II

Variable Name	
ADTLW	Is a six digit integer variable with a range of 0 to 999999. ADTLW is the average daily traffic low volume which you want the program to test for.
ADTHI	Is a six digit integer variable with a range of 0 to 999999. ADTHI is the average daily traffic high volume which you want the program to test for.
XSUB1	Is a five digit real variable with a range of 0.0 to 9999.9. XSUB1 represents the low value of the longitudinal Universal Transverse Mercador projection to be tested for.
XSUB2	Is a five digit real variable with a range of 0.0 to 9999.9. XSUB2 represents the high value of the longitudinal Universal Transverse Mercador projection to be tested for.
YSUB1	Is a five digit real variable with a range of 0.0 to 9999.9. YSUB1 represents the low value of the latitudinal Universal Transverse Mercador projection to be tested for.
YSUB2	Is a five digit real variable with a range of 0.0 to 9999.9. YSUB2 represents the high value of the latitudinal Universal Transverse Mercador projection to be tested for.

The following variables

STATEC, CTYNO, SPTOPC, CPALTC, GENLUC, ACTONC, PROMOC, CHANAC, FCLSSC, SPDMDC are all arrays. Each member of the above arrays is set up so that the program tests for the given type variable in the link if a 1 is entered. If a 0 is entered in the column then the test is not performed.

(STATEC(J), J=1,3) is a 1 by 3, array with each variable being one digit in length and of integer value.

STATEC (1)	Test for not present.
STATEC (2)	Test for Missouri
STATEC (3)	Test for Illinois.

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(CTYNO(J),J=1,13) Is a 1 by 13 array with each variable being one digit in length and of integer value.

CTYNO (1)	Test for unknown.
CTYNO (2)	Test for St. Louis City.
CTYNO (3)	Test for St. Louis County.
CTYNO (4)	Test for St. Charles County.
CTYNO (5)	Test for Jefferson County
CTYNO (6)	Test for Franklin County.
CTYNO (7)	Test for Bond County.
CTYNO (8)	Test for Clinton County.
CTYNO (9)	Test for Madison County.
CTYNO (10)	Test for Monroe County.
CTYNO (11)	Test for Randolph County.
CTYNO (12)	Test for St. Clair County.
CTYNO (13)	Test for Washington County.

(SPTOPC(J),J=1,5) Is a 1 by 5 array with each variable being one digit in length and of integer value.

SPTOPC (1)	Test for not present.
SPTOPC (2)	Test for deep cut.
SPTOPC (3)	Test for high fill.
SPTOPC (4)	Test for street canyon.
SPTOPC (5)	Test for rolling topography.

(CPALTC(J),J=1,6) Is a 1 by 6 array with each variable being one digit in length and of integer value.

CPALTC (1)	Test for not present.
CPALTC (2)	Test for complex interchange.
CPALTC (3)	Test for lane reductions.
CPALTC (4)	Test for bottlenecks.
CPALTC (5)	Test for lane reductions and bottlenecks.
CPALTC (6)	Test for complex interchanges and bottlenecks.

(SENLUC(J),J=1,8)

SENLUC (1)	Test for not present.
SENLUC (2)	Test for commercial development.
SENLUC (3)	Test for industrial development.
SENLUC (4)	Test for recreational development.
SENLUC (5)	Test for hospital.
SENLUC (6)	Test for university or college.
SENLUC (7)	Test for airport development.
SENLUC (8)	Test for multi-family development.

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(ACTCNC(J),J=1,6)	Is a 1 by 6 array with each variable being one digit and integer in value.
ACTCNC (1)	Test for not present.
ACTCNC (2)	Test for Central Business District.
ACTCNC (3)	Test for fringe area.
ACTCNC (4)	Test for outlying business district.
ACTCNC (5)	Test for residential area.
ACTCNC (6)	Test for rural area.
(PROMOC(J),J=1,5)	Is a 1 by 5 array with each variable being one digit and integer in value.
PROMOC (1)	Test for not present.
PROMOC (2)	Test for pre-timed progressive.
PROMOC (3)	Test for inter-connected progressive signals.
PROMOC (4)	Test for one-way street flow without signal progression.
PROMOC (5)	Test for one-way street flow with signal progression.
(CHANAC(J),J=1,2)	Is a 1 by 5 array with each variable being one digit in length and of integer value.
CHANAC (1)	Test for no channelization.
CHANAC (2)	Test for channelization.
(FCLSSC(J),J=1,5)	Is a 1 by 5 array with each variable being one digit and integer in value.
FCLSSC (1)	Test for not present.
FCLSSC (2)	Test for freeway.
FCLSSC (3)	Test for principal arterial.
FCLSSC (4)	Test for minor arterial.
FCLSSC (5)	Test for collector.
FCLSSC (6)	Test for local.

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LDISH	If a four digit real variable with a range of from 0.00 to 99.99. LDISH represents the high distance range for which the program will test for.
LDISL	Is a four digit real variable with a range of from 0.00 to 99.99. LDISL represents the low distance range for which the program will test for.
PKSPDH	Is a two digit integer variable with a range of 0 to 99. PKSPDH represents the high average daily speed minus the A node to B node and B node to A node peak speed for which the program will test.
PKSPDL	Is a two digit integer variable with a range of 0 to 99. PKSPDL represents the low average daily speed minus the A node to B node and B node to A node peak speed for which the program will test.
TRKVHI	Is a four digit integer variable with a range of 0 to 9999. TRKVHI represents the high volume of trucks that the program will test for on the given links.
TRKVLW	Is a four digit integer variable with a range of 0 to 9999. TRKVLW represents the low volume of trucks that the program will test for on the given links.
BUSHI	Is a three digit variable with a range of 0 to 999. BUSHI represents the high volume of busses that the program will test for on the given link.
BUSLW	Is a three digit variable with a range of 0 to 999. BUSLW represents the low volume of busses that the program will test for on the giver link.
VOCHI	Is a decimal variable corresponding to X.XX. VOCHI is the high peak volume over capacity ratio which the program will test for.
VOCLW	Is a decimal variable corresponding to X.XX. VOCLW is the low peak volume over capacity ratio which the program will test for.

A-9 NETSEN II: OUTPUT FORMAT EXPLANATIONS AND EXAMPLES

SUBROUTINE NETPRT OUTPUT

A copy of the Roadway Inventory File to be used as input by NETSEN II can be printed by a subroutine within NETSEN II. The subroutine NETPRT is activated by the characters 'YES' being punched in the first three columns of the first control card of NETSEN II. If the roadway inventory file is not to be printed then the characters 'NO' should be punched into the first two columns of the first control card instead.

A copy of the output from the subroutine NETPPT appears in Figure A. This output is printed for every link of the roadway network inventory file to be inputted into NETSEN II. This output can be printed on 8½" by 11" computer output forms or any other standard computer output forms.

OUTPUT EXPLAINATION: SUBROUTINE NETPRT

On the following pages appears the explanation of the variables found in Figure A.

1. ROUTE: This is the name of the route of the link under discussion. Each link has its own individual output sheet.

2. CROSS STREET: This is the name of the street that intersects the route at one of the links end points.

3. CROSS STREET: This is the name of the street that intersects the route at one of the links end points.

4. LINK NUMBER: The link number is a unique number assigned to every link.

5. GRID NUMBER: This is the EPA:RAPS grid number where the link resides.

6. ANODE NUMBER: This represents the unique number assigned to the A node of the link, within the network.

7. ANODE LEG#: The A node leg number has values of from 0 to 3 representing the direction from the A node number of the link. The

FIGURE A

```
REGIONAL AIR POLLUTION STUDY ST LOUIS LINE SOURCE LISTING

 1. ROUTE ILL-161..............

 2. CROSS STREET I01-01...............    4. LINK NUMBER  ..J011

 3. CROSS STREET I01-01...............    5. GRID NUMBER  .2290

 6. ANODE NUMBER  ....0                   7. ANODE LEG #  .0

 8. BNODE NUMBER  ....0                   9. BNODE LEG #  .0

10. ANODE UTM X  .760.00                 12. BNODE UTM X  .761.10

11. ANODE UTM Y  4299.30                 13. BNODE UTM Y  4299.20

14. STATE #   ..2                        15. COUNTY #  ..8
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
                MAXIMUM HOUR PEAK VOLUME INFORMATION

16. DIRECTION .0 .0  18. HOUR BEGINS .0.0. .0  20. VOLUME ....0

17. DIRECTION .0 .0  19. HOUR BEGINS .0.0. .0  21. VOLUME ....0
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *

22. SEGMENT DISTANCE  ..1.10 KM

23. ADT VOLUME  ...2500

24. PEAK HOUR PERCENT .0.0 %   25. AVERAGE DAILY SPEED  .29 MPH

26. AM PEAK SPEED   ..0 MPH    27. AM DIRECTION ..6

28. PM PEAK SPEED   ..0 MPH    29. PM DIRECTION ..6

30. A TO B CAPACITY  ...600    31. B TO A CAPACITY  ...600

32. TRUCK VOLUME  ..10         33. TRUCK PERCENT  .0.40 %

34. BUS VOLUME    ...0         35. BUS PERCENT    .0.0  %

36. SPECIAL TOPOGRAPHY      ...0

37. CAPACITY ALTERATIONS    ...0

38. SENSITIVE LAND USE      ...0

39. ACTIVITY CENTERS        ...0

40. PROGRESSIVE MOVEMENT    ...0

41. CHANNELIZATION          ...0

42. FUNCTIONAL CLASS        ...2
```

value 0 is equal to an intersection leg in a northern direction, 1 is equal to east, 2 is equal to south, and 3 equals west.

8. BNODE NUMBER: This represents the unique number assigned to the B node of the link, within the network.

9. BNODE LEG#: The B node leg number has values of from 0 to 3 representing the direction from the B node number of the link. The value 0 is equal to an intersection leg in a northern direction, 1 is equal to east, 2 is equal to south, and 3 equals west.

10. ANODE UTM X: The longitudinal Universal Transverse Mercator projection for the A node.

11. ANODE UTM Y: The latitudinal Universal Transverse Mercator projection for the A node.

12. BNODE UTM X: The longitudinal Universal Transverse Mercator projection for the B node.

13. BNODE UTM Y: The latitudinal Universal Transverse Mercator projection for the B node.

14. STATE #: The state of the United States in which the link resides. The value of 1 represents MISSOURI and 2 represents ILLINOIS.

15. COUNTY #: The county in which the link resides: The value of

1 is St. Louis City
2 is St. Louis County
3 is St. Charles County
4 is Jefferson County
5 is Franklin County
6 is Bond County
7 is Clinton County
8 is Madison County
9 is Monroe County
10 is Randolph County
11 is St. Clair County
12 is Washington County

Maximum hour peak volume information

16. DIRECTION: The first number is the type of facility. One-way is coded as a 1, two-way is 2, and ruversible is 3. The second number refers to the direction of this facility during the peak hour under consideration. Northbound is coded as 1, southbound equals 2, eastbound equals 3, and westbound equals 4.

17. DIRECTION: Corresponds to '16. DIRECTION' except this is for the other peak period of the day.

18. HOUR BEGINS: The beginning of the peak hour for the link. The first two characters correspond to the hours of the day and the last two characters correspond to the minutes. The second number corresponds to the AM or PM of the day. AM is coded as a 1, PM is coded as a 2.

19. HOUR BEGINS: Corresponds to '18. HOUR BEGINS' except this is for the other peak period of the day.

20. VOLUME: This is the peak hour volume for the link.

21. VOLUME: Corresponds to '20. VOLUME' except this is for the other peak period of the day.

22. SEGMENT DISTANCE: Is the distance from the A node to the B node of the link in kilo-meters (km).

23. ADT VOLUME: Is the Average Daily Traffic Volume for the link.

24. PEAK HOUR PERCENT: Is the percent of the Average Daily Traffic (ADT) that represents the peak hour traffic per direction.

25. AVERAGE DAILY SPEED: Is the average daily speed for the link in mph.

26. AM PEAK SPEED: Is the AM peak speed for the link in mph.

27. AM DIRECTION: Is the direction of the AM peak speed. A northbound direction is coded as a 1, southbound 2, eastbound 3, and westbound 4.

28. PM PEAK SPEED: Is the PM peak speed for the link in mph.

29. PM DIRECTION: Is the direction of the PM peak speed. A northbound direction is coded as a 1, southbound 2, eastbound 3, and westbound 4.

30. A TO B CAPACITY: The capacity from the A node to the B node.

31. B TO A CAPACITY: The capacity from the B node to the A node.

32. TRUCK VOLUME: The daily truck volume for the link under consideration.

33. TRUCK PERCENT: Is the average daily truck volume expressed as a percent of Average Daily Traffic (ADT).

34. BUS VOLUME: The daily bus volume for the link under consideration.

35. BUS PERCENT: Is the average daily bus volume expressed as a percent of Average Daily Traffic (ADT).

36. SPECIAL TOPOGRAPHY: This represents the special topography conditions and has value ranging from 0 to 4 with 0 equaling not present, 1 equals deep cut, 2 equals high fill, 3 equals street canyon, and 4 equals rolling topography.

37. CAPACITY ALTERATIONS: This represents the capacity alterations for the link and has values ranging from 0 to 5 with 0 equaling not present, 1 equals complex interchanges, 2 equals lane reduction, 3 equals bottleneck segment, 4 equals lane reduction and bottleneck segment, and 5 equals complex interchanges and bottleneck segment.

38. SENSITIVE LAND USE: This represents sensitive land use conditions along the link and has values ranging from 0 to 7 with 0 equaling not present, 1 equaling commercial development, 2 equaling residential development, 3 equaling recreation, 4 equaling hospitals, 5 equaling universities or colleges, 6 equaling airports and 7 equaling multi-family development.

39. ACTIVITY CENTERS: This represents the activity centers for the link under consideration. It has values ranging from 0 to 5 with 0 equaling not present, 1 equaling CBD (Central Business District), 2 equaling

fringe area, 3 equaling outlying business district, 4 equaling residential area and 5 equaling rural area.

40. PROGRESSIVE MOVEMENT: This represents the progressive movement within the link. Values range from 0 to 4 with 0 equaling not present, 1 equaling pre-timed progressive, 2 equaling interconnected progressive signal, 3 equaling one-way street flow with signal progression, and 4 equaling one-way street flow with signal progression.

41. CHANNELIZATION: This represents the channelization of the link. Values are 0 or 1 with 0 being not channelized and 1 equaling channelized.

42. FUNCTIONAL CLASS: This represents the functional class of the link under consideration. Values range from 0 to 5 with 0 being not known, 1 equaling freeway, 2 equaling principal arterial, 3 equaling minor arterial, 4 equaling collector, and 5 equaling local.

SUBROUTINE GRIDRT OUTPUT

On the following page is the output from subroutine GRIDRT. This routine writes out the grid number, links that are in this grid set, the total number of links in this grid, the total number of kilometers of roadway in this grid, the total vehicle kilometers traveled in the grid (VKT = ADT x link distance), and the break down by functional class of VKT's. The routine does the above for all grids specified. The routine also writes on to disk those links printed out above.

```
OUTPUT FROM SUBROUTINE GRIDVT FOLLOWS

 THE FOLLOWING LINKS ARE IN GRID NUMBER    2127

8  I-70                    INT PT                FIFTH STREET                 0     0.32   1
8  I-70                    FIFTH STREET          COUNTY LINE              65896     1.10   1
8  I-70                    COUNTY LINE           INT PT                   65896     0.52   1
   THERE ARE          3 LINKS IN GRID NUMBER      2127
    THESE LINKS ACCOUNT FOR      1.92 KILOMETERS OF ROADWAY

    THERE ARE  106741.69 VEHICLE KILOMETERS TRAVELED (VKT) IN THIS GRID

          FREEWAY VKT =  106741.69
          PRINCIPLE ARTERIAL VKT =        0.0
          MINOR ARTERIAL VKT =        0.0
          COLLECTOR VKT =        0.0
          LOCAL VKT =        0.0

 THE FOLLOWING LINKS ARE IN GRID NUMBER    2164

8  I-70                    EARTH CITY EXPRESSWAY I-270                    65896     1.60   1
8  I-270                   I-70                  INT PT                   79377     0.70   1
8  I-270                   INT PT                ST. CHARLES ROCK RD      79377     0.51   1
8  I-270                   INT PT                I-70                     91796     0.75   1
8  I-70                    I-270                 INT PT                   56016     0.50   1
   THERE ARE          5 LINKS IN GRID NUMBER      2164
    THESE LINKS ACCOUNT FOR      4.06 KILOMETERS OF ROADWAY

    THERE ARE  298317.56 VEHICLE KILOMETERS TRAVELED (VKT) IN THIS GRID

          FREEWAY VKT =  298317.56
          PRINCIPLE ARTERIAL VKT =        0.0
          MINOR ARTERIAL VKT =        0.0
          COLLECTOR VKT =        0.0
          LOCAL VKT =        0.0

 THE FOLLOWING LINKS ARE IN GRID NUMBER     763

8  I-70                    LUCAS AND HUNT        INT PT                   97690     1.10   1
   THERE ARE          1 LINKS IN GRID NUMBER       763
    THESE LINKS ACCOUNT FOR      1.10 KILOMETERS OF ROADWAY

    THERE ARE  107458.94 VEHICLE KILOMETERS TRAVELED (VKT) IN THIS GRID

          FREEWAY VKT =  107458.94
          PRINCIPLE ARTERIAL VKT =        0.0
          MINOR ARTERIAL VKT =        0.0
          COLLECTOR VKT =        0.0
          LOCAL VKT =        0.0
```

SUBROUTINE LINKRT OUTPUT

On the following page is the output from subroutine LINKRT. This routine writes the link number, route name and cross streets of the link being searched for. This routine can search for a set of links also and these will be outputted in the same manner, following the last link searched for is a listing of the number of links tested, the total amount of kilometers of roadway, and the total VKT's for the set.

```
OUTPUT FROM SUBROUTINE [illegible] FIELDS

[illegible] PAGE                [illegible]               SEGMENT

THERE ARE          1 LINKS TESTED IN THIS SUBROUTINE
   THESE LINKS ACCOUNT FOR      [illegible] KILOMETERS OF ROADWAY
   THESE LINKS ACCOUNT FOR        [illegible] VEHICLE KILOMETERS TRAVELED DAILY
```

SUBROUTINE NETSRT

On the following page is the output from subroutine NETSRT. This is the network sort routine. The output begins with the listing characteristics tested for. Following this is the list of characteristics not tested for. Finally, the set of links which passed is outputted. This includes the links link number, route name, cross streets, ADT, and link distance. After this listing is total information giving the number of links in this set, total amount of kilometers of roadway, and the VKT (vehicle kilometers traveled) for the set.

```
THE FOLLOWING LINK CHARACTERISTIC(S) TESTED FOR.

     ACT>I: AVG.DAILY TRAFFIC         60001  TO    80000
     RCLSSC(2)= TEST FOR FREEWAY
     V OVER C, PEAK          0.61  TO    0.90

THE FOLLOWING LINK CHARACTERISTIC(S) NOT TESTED FOR.

     YSUB1=    0.0  YSUB2=    0.0        *SUB1=      0.0  *SUB2=      0.0
     STATEC(1)= TEST FOR NOT PRESENT
     STATEC(2)= TEST FOR MISSOURI
     STATEC(3)= TEST FOR ILLINOIS
     CTYNOC(1)= TEST FOR UNKNOWN
     CTYNOC(2)= TEST FOR ST. LOUIS CITY
     CTYNOC(3)= TEST FOR ST. LOUIS COUNTY
     CTYNOC(4)= TEST FOR ST. CHARLES COUNTY
     CTYNOC(5)= TEST FOR JEFFERSON COUNTY
     CTYNOC(6)= TEST FOR FRANKLIN COUNTY
     CTYNOC(7)= TEST FOR BOND COUNTY
     CTYNOC(8)= TEST FOR CLINTON COUNTY
     CTYNOC(9)= TEST FOR MADISON COUNTY
     CTYNOC(10)= TEST FOR MONROE COUNTY
     CTYNOC(11)= TEST FOR RANDOLPH COUNTY
     CTYNOC(12)= TEST FOR ST. CLAIR COUNTY
     CTYNOC(13)= TEST FOR WASHINGTON COUNTY
     SPTOPC(1)= TEST FOR NOT PRESENT
     SPTOPC(2)= TEST FOR DEEP CUT
     SPTOPC(3)= TEST FOR HIGH FILL
     SPTOPC(4)= TEST FOR STREET CANYON
     SPTOPC(5)= TEST FOR ROLLING TOPOGRAPHY
     CPALTC(1)= TEST FOR NOT PRESENT
     CPALTC(2)= TEST FOR COMPLEX INTERCHANGE
     CPALTC(3)= TEST FOR LANE REDUCTIONS
     CPALTC(4)= TEST FOR BOTTLENECKS
     CPALTC(5)= TEST FOR LANE REDUCTIONS AND BOTTLENECKS
     CPALTC(6)= TEST FOR COMPLEX INTERCHANGES AND BOTTLENECKS
     SENLUC(1)= TEST FOR NOT PRESENT
     SENLUC(2)= TEST FOR COMMERCIAL DEVELOPMENT
     SENLUC(3)= TEST FOR INDUSTRIAL DEVELOPMENT
     SENLUC(4)= TEST FOR RECREATIONAL DEVELOPMENT
     SENLUC(5)= TEST FOR HOSPITAL
     SENLUC(6)= TEST FOR UNIVERSITY OR COLLEGE
     SENLUC(7)= TEST FOR AIRPORT DEVELOPMENT
     SENLUC(8)= TEST FOR MULTI-FAMILY DEVELOPMENT
     ACTCNC(1)= TEST FOR NOT PRESENT
     ACTCNC(2)= TEST FOR CENTRAL BUSINESS DISTRICT
     ACTCNC(3)= TEST FOR FRINGE AREA
     ACTCNC(4)= TEST FOR OUTLYING BUSINESS DISTRICT
     ACTCNC(5)= TEST FOR RESIDENTIAL AREA
     ACTCNC(6)= TEST FOR RURAL AREA
     PRCMDC(1)= TEST FOR NOT PRESENT
     PRCMDC(2)= TEST FOR PRE-TIMED PROGRESSIVE
```

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```
[illegible](13): TEST FOR INTERCONNECTED PROGRESSIVE SIGNALS
[illegible](14): TEST FOR ONE-WAY STREET FLOW WITHOUT SIGNAL PROGRESSION
[illegible](15): TEST FOR ONE-WAY STREET FLOW WITH SIGNAL PROGRESSION
CHANNC(1): TEST FOR NO CHANNELIZATION
CHANNC(2): TEST FOR CHANNELIZATION
FCLSSC(1): TEST FOR NOT PRESENT
FCLSSC(3): TEST FOR PRINCIPLE ARTERIAL
FCLSSC(4): TEST FOR MINOR ARTERIAL
FCLSSC(5): TEST FOR COLLECTOR
FCLSSC(6): TEST FOR LOCAL
DISTANCE OF LINK        0.0   TO   0.0
PEAK SPEED            0  TO      0
TRUCK VOLUME            0 TO     0
BUS VOLUME            0 TO     0

THE FOLLOWING LINKS PASSED TESTS

 304   RT 40          I-270              DALLAS RD              [illegible]   2.52
 [illegible]   RT 40          DALLAS RD          INT PT                 [illegible]   [illegible]
 [illegible]   I-270          INT PT             INT PT                 [illegible]   [illegible]
 [illegible]   I-270          INT PT             BIG BEND               [illegible]   [illegible]
 [illegible]   RT 40          INT PT             INT PT                 [illegible]   [illegible]
 [illegible]   RT 40          INT PT             [illegible]            [illegible]   [illegible]
 [illegible]   RT 40          LINDBERGH          INT PT                 [illegible]   [illegible]
 [illegible]   I-270          INT PT             [illegible]            [illegible]   [illegible]
 [illegible]   RT 40          INT PT             CLAYTON RD             [illegible]   [illegible]
 [illegible]   I-70           LINDBERGH          INT PT                 [illegible]   [illegible]
 [illegible]   I-70           INT PT             CYPRESS RD             [illegible]   [illegible]
 [illegible]   I-270          INT PT             INT PT                 [illegible]   [illegible]
 [illegible]   I-270          INT PT             GRAHAM RD              [illegible]   [illegible]
 [illegible]   I-70           CARSON RD          INT PT                 [illegible]   [illegible]
 [illegible]   I-270          NEW FLORISSANT     OLD FLORISSANT         [illegible]   [illegible]
 [illegible]   I-70           INT PT             NEW FLORISSANT         [illegible]   [illegible]
 [illegible]   I-270          OLD FLORISSANT     INT PT                 [illegible]   [illegible]
 [illegible]   I-55           BAYLASS            INT-PT                 [illegible]   [illegible]
 [illegible]   INT-PT         INT-PT             BAYLASS                [illegible]   [illegible]
 [illegible]   I-270          INT PT             WEST FLORISSANT        [illegible]   [illegible]
 [illegible]   I-55           WEBER              INT-PT                 [illegible]   [illegible]
 [illegible]   I-270          WEST FLORISSANT    INT PT                 [illegible]   [illegible]
 [illegible]   I-270          INT PT             NEW HALLS FERRY        [illegible]   [illegible]
 [illegible]   RT-40          NEWSTEAD-AVE       INT-PT                 [illegible]   [illegible]
 [illegible]   RT-40          INT-PT             VANDEVENTER-AVE        [illegible]   [illegible]
 [illegible]   I-55           INT-PT             MICHIGAN-AVE           [illegible]   [illegible]
 [illegible]   I-55           BROADWAY           INT-PT                 [illegible]   [illegible]
 [illegible]   RT-40          GRAND-BLVD         MARKET-STR             [illegible]   [illegible]
 [illegible]   I-55           INT-PT             BROADWAY               [illegible]   [illegible]
 [illegible]   I-55           INT-PT             INT-PT                 [illegible]   [illegible]
 [illegible]   I-55           BROADWAY           INT-PT                 [illegible]   [illegible]
 [illegible]   I-55           INT-PT             ARSENAL-AVE            [illegible]   [illegible]
 [illegible]   I-55           GRAVOIS            INT-PT                 [illegible]   [illegible]
 [illegible]   I-44           RT-141             INT-PT                 [illegible]   [illegible]
 [illegible]   I-70           COUNTY LINE        INT PT                 [illegible]   [illegible]
 [illegible]   I-70           INT PT             FIFTH STREET           [illegible]   [illegible]
 [illegible]   I-70           FIFTH STREET       COUNTY LINE            [illegible]   [illegible]
 [illegible]   I-44           INT-PT             INT-PT                 [illegible]   [illegible]
 [illegible]   I-70           INT PT             EARTH CITY EXPRESSWAY  [illegible]   [illegible]
 [illegible]   I-70           INT PT             INT PT                 [illegible]   [illegible]
```

```
2666   I-270         I-44                  INT PT              77790    3.50
2672   I-44          INT-PT                I-244               62031    3.40
2680   I-70          EARTH CITY EXPRESSWY  I-270               65090    1.60
2730   I-270         ST. CHARLES ROCK RD.  INT PT              70001    4.40
2737   I-270         INT PT                INT PT              70001    1.95
2746   I-270         INT PT                FRANCIS 130A        62037    3.30
2750   I-270         BROWN RD              INT PT              60842    0.45
2770   I-270         INT PT                INT PT              62037    3.40
2781   I-270         INT PT                INT PT              62037    1.95
2785   I-270         INT PT                INT PT              60842    2.25
2811   I-55          INT-PT                BUTLER-HILL-RD      64283    2.80
2817   I-270         TESSON FERRY          INT PT              62037    0.30
2827   I-270         N LINDBERGH           INT PT              75673    0.90
2836   I-270         INT PT                N LINDBERGH         60842    0.90
2856   I-55          INT-PT                INT-PT              64283    0.80
2858   I-55          I-244                 INT-PT              64283    0.90
2864   I-55          INT-PT                REAVIS-BARRACKS     70741    1.00

THERE ARE       57 LINKS THAT MEET THE ABOVE PARAMETERS TESTED
  THESE LINKS ACCOUNT FOR     49.38 KILOMETERS OF ROADWAY

  THESE LINKS ACCOUNT FOR   3469987.00 VEHICLES KILOMETERS TRAVELED (VKT)
```

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A-10 NETSEN II: PROGRAM LISTING

```
IV G LEVEL  21                    MAIN                DATE = 76160          18/29/44

      C*********************************************************************** **
      C
      C**************PROGRAM NETSEN II*******************************************
      C
      C**************************************************************************
      C
      C         INPUT: CONTROL CARDS=CARD READER, UNIT=05
      C         INPUT: DATA CARDS=DISK, UNIT=04
      C
      C         OUTPUT: LINE PRINTER, UNIT=06
      C         OUTPUT: SUBROUTINE NETSRT=DISK, UNIT=12
      C
      C
      C         IBM 360-65
      C         FORTRAN IV  LEVEL G
      C         PROGRAM NETSEN II VERSION DATE NOV. 24, 1975
      C
      C         AUTHOR DON LANG, WASHINGTON UNIVERSITY
      C         DEPT OF CIVIL ENGINEERING
      C         TRANSPORTATION AND URBAN PLANNING
      C
      C
      C         FOR THE ENVIRONMENTAL PROTECTION AGENCY
      C
      C
      C**************************************************************************
            DATA YES/'YES'/
      C*********************************************************************** **
      C         TEST FOR SUBPROGRAM NETPRT
      C**************************************************************************
            READ(5,10)CC1
      10    FORMAT(A3)
            IF(CC1.EQ. YES ) CALL NETPRT
      C*********************************************************************** **
      C         TEST FOR SUBPROGRAM GRIDRT
      C**************************************************************************
            READ(5,20)CC2
      20    FORMAT(A3)
            IF(CC2.EQ. YES ) CALL GRIDRT
      C*********************************************************************** **
      C         TEST FOR SUBPROGRAM LINKRT
      C**************************************************************************
            READ(5,30)CC3
      30    FORMAT(A3)
            IF(CC3.EQ. YES )CALL LINKRT
      C*********************************************************************** **
      C         TEST FOR SUBPROGRAM NETSRT
      C**************************************************************************
```

```
 35     READ(5,40,END=1000)CC4
 40     FORMAT(A3)
        IF(CC4.EQ.'YES') CALL NETSRT
C***********************************************************************
C           END OF PROGRAM
C***********************************************************************
 1000   CONTINUE
        STOP
        END
```

```
      WRITE(6,45)
45    FORMAT('1',10X,'OUTPUT FROM SUBROUTINE NETPRT FOLLOWS')
C**********************************************************************
C         READ RECORDS FROM ROADWAY INVENTORY FILE.
C**********************************************************************
50    READ(ISW,52,END=1000) ANODE,LEGA,BNODE,LEGB,UTMAX,UTMAY,UTMBX,
     * UTMBY,STATEN,CTYN ,GRIDNO,(RTNAME(J),J=1,5),(CRSSTA(J),J=1,5),
     *              (CRSSTB(J),J=1,5),LNKNO ,LDIS,ACT,PKHRP,AVDI1,
     *   AVDI2,AMAXHR,AVTIME,AVVOL,BVDI1,
     *  BVDI2,BMAXHR,BVTIME,BVVOL,
     * ADASPD ,      AMPKSP  ,AMDIR,PMPKSP,PPDIR,
     *             ACPACT, BCPACT,TRUKVL,TRUKPC, BUSVL,BUSPC,
     * SPTOPL, GPALTL, SENLUL,ACTCNT, PROPOL,CHANAL,FCLSSL
52    FORMAT(I5,I1,I5,I1,4F5.1,I1,I2,I5,5A4,5A4,
     *        5A4,I6,F4.2,I6,F2.2,2I1,F4.2,I1,I4,2I1,F4.2,I1,I4,6X,2I2,
     * I1,I2,I1,6X,
     *        I5,I5,I4,F2.2,I4,F2.2,7I1)
C**********************************************************************
C         CALL SUBROUTINE NPRINT.
C**********************************************************************
      CALL NPRINT
C**********************************************************************
C         GO BACK AND READ ANOTHER RECORD.
C**********************************************************************
      ISAVE=ISAVE+1
      SAVE=SAVE+LDIS
      GO TO 50
C**********************************************************************
C         PRINT END OF OUTPUT FROM NETPRT.
C**********************************************************************
1000  CONTINUE
      WRITE(6,1005) ISAVE,SAVE
1005  FORMAT('1'/// 5X,'THERE ARE ',I8,' LINKS IN THE ROADWAY NETWORK'
     * , /,5X,'ACCOUNTING FOR A TOTAL OF ',F8.2, ' KILOMETERS')
      WRITE(6,1010)
1010  FORMAT('0',10X,'END OF OUTPUT FROM SUBROUTINE NETPRT')
C**********************************************************************
C         END OF SUBROUTINE NETPRT.
C**********************************************************************
      REWIND4
      RETURN
      END
      SUBROUTINE NPRINT
C***********************************************************************
C
C         SUBROUTINE NPRINT PRINTS THE OUTPUT LINE SOURCE FORM
C         FOR EACH LINE SOURCE IN THE ROADWAY DATA FILE. THIS
C         SUBROUTINE IS CALLED BY SUBROUTINE NETPRT.
C
C***********************************************************************
C***********************************************************************
C         SETTING UP COMMON AREA.
C***********************************************************************
      COMMON  ANODE,LEGA,BNODE,LEGB,STATEN,CTYN ,GRIEKO           ,
     *        LNKNO,ADT,               AVTIPE,AVVOL,              BVTIPE,
     *         AVDI1,AVDI2,BVDI1,BVDI2 ,
     * BVVOL,          ADASPD,AMPKSP,AMDIR,PMPKSP,PMDIR ,
     *        ACPACT,BCPACT,TRUKVL,BUSVL,SPTOPL,CPALTL,SENLUL,ACTENT,
     * PROMOL,CHANAL,FCLSSL ,
     *     UTMAX,UTMAY,UTMBX,UTMBY              ,
     *     LOIS,PKHRP        ,
     *     TRUKPC,BUSPC
      COMMON    RTNAME(5),CRSSTA(5),CRSSTB(5)
      COMMON AMAXHR,BMAXHR
C***********************************************************************
C        INITIALIZE VARIABLES.
C***********************************************************************
      INTEGER ANODE,LEGA,BNODE,LEGB,STATEN,CTYN ,GRIEKO
      INTEGER LNKNO,ADT,               AVTIPE,AVVOL,              BVTIPE
      INTEGER  AVDI1,AVDI2,BVDI1,BVDI2 ,
     * BVVOL,          ADASPD,AMPKSP,AMDIR,PMPKSP,PMDIR
      INTEGER ACPACT,BCPACT,TRUKVL,BUSVL,SPTOPL,CPALTL,SENLUL,ACTENT,
     * PROMOL,CHANAL,FCLSSL
      REAL UTMAX,UTMAY,UTMBX,UTMBY
      REAL LOIS,PKHRP
      REAL TRUKPC,BUSPC
C***********************************************************************
C        PRINT OUT ST. LOUIS ROADWAY INVENTORY FILE SHEET.
C***********************************************************************
95    WRITE(6,100)
100   FORMAT('1',////21X,'REGIONAL AIR POLLUTION STUDY ST LOUIS'
     *    ,     ' LINE SOURCE LISTING')
      WRITE(6,104)
104   FORMAT(/  19X,29H1. ROUTE ____________________)
      WRITE(6,107)(RTNAME(J),J=1,5)
107   FORMAT('+',27X,5A4)
      WRITE(6,108)
108   FORMAT(/  19X,36H2. CROSS STREET ____________________'
     *  3X,22H4. LINK NUMBER  ______)
      WRITE(6,111)(CRSSTA(J),J=1,5),LNKNO
```

```
  111    FORMAT('+',36X,5A4,19X,I6)
         WRITE(6,112)
  112    FORMAT(/ 19X,36H3. CROSS STREET ____________________'
        * 3X,21H5. GRID NUMBER _____')
         WRITE(6,115)(CRSSTB(J),J=1,5),GRIDNC
  115    FORMAT('+',36X,5A4,19X,I5)
         WRITE(6,118)
  118    FORMAT(/ 19X,22H6. ANODE NUMBER _____,17X,
        * 10H7. ANODE LEG # __)
         WRITE(6,119)ANODE,LEGA
  119    FORMAT('+',35X,I5,33X,I2)
         WRITE(6,122)
  122    FORMAT(/ 19X,22H8. BNODE NUMBER _____,17X,
        * 10H9. BNODE LEG # __)
         WRITE(6,119) BNODE,LEGB
         WRITE(6,124)
  124    FORMAT(/ 18X,24H10. ANODE UTM X _______'
        * 15X,24H12. BNODE UTM X _______)
         WRITE(6,125)UTMAX,UTMBX
  125    FORMAT('+',34X,F7.2,32X,F7.2)
         WRITE(6,128)
  128    FORMAT(/ 18X,24H11. ANODE UTM Y _______'
        * 15X,24H13. BNODE UTM Y _______)
         WRITE(6,125) UTMAY,UTMBY
         WRITE(6,130)
  130    FORMAT(/ 18X,17H14. STATE # ___,22X,'15. CCLNTY # ___')
         WRITE(6,131) STATEN,CTYN
  131    FORMAT('+',31X,I3,36X,I3)
         WRITE(6,136)
  136    FORMAT(' ',10X,38(1X,'='))
         WRITE(6,138)
  138    FORMAT(' ',34X,24HMAXIMUM HOUR PEAK VOLUME,12H INFORMATION)
         WRITE(6,140)
  140    FORMAT(/ 18X,'16. DIRECTION __ __',2X,
        * '18. HOUR BEGINS _____ __',2X,'20. VOLUME _____')
         WRITE(6,141)AVDI1,AVDI2,AMAXHR,AVTIME,AVVCL
  141    FORMAT('+',31X,I2,1X,I2,18X,F5.2,1X,I2,13X,I5)
         WRITE(6,142)
  142    FORMAT(/ 18X,'17. DIRECTION __ __',2X,
        * '19. HOUR BEGINS _____ __',2X,'21. VOLUME _____')
         WRITE(6,141)BVDI1,BVDI2,BMAXHR,BVTIME,BVVCL
         WRITE(6,136)
         WRITE(6,144)
  144    FORMAT(/ 18X,28H22. SEGMENT DISTANCE ______,' KM')
         WRITE(6,145) LDIS
  145    FORMAT('+',39X,F6.2)
         WRITE(6,148)
  148    FORMAT(/ 18X,23H23. ADT VOLUME _______'
      WRITE(6,149) ADT
149   FORMAT('+',33X,I7)
      WRITE(6,152)
152   FORMAT(/  10X,26H24. PEAK HOUR PERCENT ----,
     * 5X,28H25. AVERAGE DAILY SPEED  ---)
      IF(ADT.EQ.0) GO TO 154
      IF(PKHRP.EQ.0) PKHRP=((AVVOL+BVVOL)/2.)/ADT
      IF(AVCI1.EQ.1) PKHRP=PKHRP*2
      PKHRP=PKHRP*100
154   WRITE(6,153) PKHRP ,ADASPD
153   FORMAT('+',39X,F4.1,' % ',27X,I3,' MPH')
      WRITE(6,164)
164   FORMAT(/  10X,23H26. AM PEAK SPEED   ---,' MPH',4X,
     * 20H27. AM DIRECTION ---)
      WRITE(6,165)AMPKSP,AMDIR
165   FORMAT('+',37X,I3,25X,I3)
      WRITE(6,168)
168   FORMAT(/  10X,23H28. PM PEAK SPEED   ---,' MPH',4X,
     * 20H29. PM DIRECTION ---)
      WRITE(6,165)PMPKSP,PMDIR
      WRITE(6,170)
170   FORMAT(/  10X,27H30. A TO B CAPACITY  ------, 4X,
     * 27H31. B TO A CAPACITY  ------)
      WRITE(6,171)ACPACT,BCPACT
171   FORMAT('+',38X,I6,25X,I6)
      WRITE(6,174)
174   FORMAT(/  10X,22H32. TRUCK VOLUME  ----, 9X,
     * 23H33. TRUCK PERCENT  ----)
      IF(ADT.EQ.0) GO TO 177
      IF(TRUKPC.EQ.0.)TRUKPC=(TRUKVL*1.)/ADT
      IF(TRUKVL.EQ.0.AND.TRUKPC.GT.0.)TRUKVL=ADT*TRUKPC*.01
177   TRUKPC=TRUKPC*100
176   WRITE(6,175)TRUKVL,TRUKPC
175   FORMAT('+',35X,I4,28X,F5.2,' %')
      WRITE(6,178)
178   FORMAT(/  10X,22H34. BUS VOLUME   ----, 9X,
     * 23H35. BUS PERCENT   ----)
      IF(ADT.EQ.0) GO TO 1780
      IF(BUSPC.EQ.0.)BUSPC=(BUSVL*1.)/ADT
      IF(BUSVL.EQ.0.AND.BUSPC.GT.0.)BUSVL=ADT*BUSPC*.01
1780  BUSPC=BUSPC*100
179   WRITE(6,175) BUSVL,BUSPC
      WRITE(6,180)
180   FORMAT(/  10X,22H36. SPECIAL TOPOGRAPHY,5X,4H----)
      WRITE(6,181) SPTOPL
181   FORMAT('+',44X,I4)
      WRITE(6,184)
184   FORMAT(/  10X,31H37. CAPACITY ALTERATIONS   ----)
```

```
         WRITE(6,181)CPALTL
         WRITE(6,186)
   186   FORMAT(/  10X,31H38. SENSITIVE LAND USE      ....)
         WRITE(6,181)SENLUL
         WRITE(6,188)
   188   FORMAT(/  10X,24H39. ACTIVITY CENTERS     ,5X,4H....)
         WRITE(6,181)ACTCNT
         WRITE(6,190)
   190   FORMAT(/  10X,31H40. PROGRESSIVE MOVEMENT    ....)
         WRITE(6,181)PROMOL
         WRITE(6,192)
   192   FORMAT(/  10X,18H41. CHANNELIZATION,9X,4H....)
         WRITE(6,181)CHANAL
         WRITE(6,194)
   194   FORMAT(/  10X,20H42. FUNCTIONAL CLASS,7X,4H....)
         WRITE(6,181) FCLSSL
C**********************************************************************
C           END OF SUBROUTINE NPRINT.
C**********************************************************************
         RETURN
         END
```

```
      SUBROUTINE GRIDRT
C***********************************************************************
C
C          SUBROUTINE GRIDRT TESTS SPECIFIED GRIDS FOR LINE SOURCES
C          CONTAINED IN IT.  OUTPUT CONSISTS OF THESE MEMBER LINE
C          SOURCES PLUS AN OUTPUT TABLE OF VEHICLE KILOMETERS
C          TRAVELED PER GRID BY FUNCTIONAL CLASS.
C
C***********************************************************************
C***********************************************************************
C          INITIALIZE VARIABLES.
C***********************************************************************
      INTEGER GRIDTN
      INTEGER ANODE,LEGA,BNODE,LEGB,STATEN,CTYN ,GRIDNO
      INTEGER LNKNO,ALT,AVDIR,AMAXHR,AVTIME,AVVOL,BVDIR,BMAXHR,BVTIME,
     * BVVOL,       ADASPD,AMPKSP,AMDIR,PMPKSP,PMDIR
      INTEGER ACPACT,BCPACT,TRUKVL,BUSVL,SPTOPL,CPALTL,SENLUL,ACTCNT,
     * PROPOL,CHANAL,FCLSSL
      REAL UTMAX,UTMAY,UTMBX,UTMBY
      REAL LDIS,PKHRP
      REAL TRUKPC,BUSPC
      DIMENSION RTNAME(5),CRSSTA(5),CRSSTB(5)
      DIMENSION VRT(5)
      M=0
C***********************************************************************
C          PRINT BEGINNING OF OUTPUT FROM GRIDRT.
C***********************************************************************
      WRITE(6,10)
10    FORMAT('1',10X,'OUTPUT FROM SUBROUTINE GRIDRT FOLLOWS')
C***********************************************************************
C          INITIALIZE READER DEVICE FOR ROADWAY INVENTORY FILE.
C***********************************************************************
      ISW=5
C***********************************************************************
C          READ GRID TEST CONTROL CARD.
C***********************************************************************
15    SAVE1=0
      ISAVE1=0
      M=M+1
      DO 20 J=1,5
20    VRT(J)=0
      READ(5,25)GRIDTN
25    FORMAT(I5)
C***********************************************************************
C          TEST FOR THE END OF THE GRID TEST CONTROL CARD FILE.
C***********************************************************************
      IF(GRIDTN.EQ.99999)GO TO 1000
C***********************************************************************
```

```
C         PRINT HEADER.
C*************************************************************************
      WRITE(6,26) GRIDTN
26    FORMAT('1'//10X,'THE FOLLOWING LINKS ARE IN GRID NUMBER',I8 // )
      IF(M.GT.1) GO TO 40
C*************************************************************************
C         READ RECORD FROM ROADWAY INVENTORY FILE.
C*************************************************************************
27    READ(ISW,30,END=900)
     *            ANODE,LEGA,BNODE,LEGB,UTMAX,UTMAY,UTMBX,UTMBY,
     * STATEN,CTYN ,GRIDNO,(RTNAME(J),J=1,5),(CRSSTA(J),J=1,5),
     *           (CRSSTB(J),J=1,5),LNKNO ,
     * LDIS,ADT,PKHRP,AVDIR,AMAXHR,AVTIME,AVVOL,BVDIR,BMAXHR,BVTIME,
     * BVVOL,       ADASPD,AMPKSP,AMDIR,PMPKSP,PMDIR,
     * ACPACT,BCPACT,TRUKVL,
     *                TRUKPC,BUSVL,BUSPC,SPTOPL,CPALTL,SENLUL,
     * ACTCNT, PROMOL,CHANAL,FCLSSL
30    FORMAT(I5,I1,I5,I1,4F5.1,I1,I2,I5,5A4,5A4,
     *       5A4,I6,F4.2,I6,F2.2,I2,I4,I1,I4,I2,I4,I1,I4,4X,2X,I2,I2,
     * I1,I2,I1,6X,
     *       I5,I5,I4,F2.2,I4,F2.2,7I1)
C*************************************************************************
C         TEST IF LINK IS IN GRID TO BE TESTED FOR.
C*************************************************************************
40    IF(GRIDTN.EQ.GRIDNO)GO TO 50
      IF(GRIDTN.LT.GRIDNO) GO TO 900
      GO TO 27
C*************************************************************************
C         WRITE LINKS THAT ARE IN TESTED GRIDS.
C*************************************************************************
50    WRITE(6,51)LNKNO,(RTNAME(J),J=1,5),(CRSSTA(J),J=1,5),
     * (CRSSTB(J),J=1,5) ,ADT,LDIS,FCLSSL
51    FORMAT(' ',2X,I6,2X,5A4,2X,5A4,2X,5A4,2X,I7,2X,F6.2,2X,I2)
      IUTMA=UTMAX*10
      IUTMB=UTMAY*10
      IUTMC=UTMBX*10
      IUTMD=UTMBY*10
      IDIS=LDIS*100
      IPKHR=PKHRP*100
      ITRUCK=TRUKPC*100
      IBUSP=BUSPC*100
      WRITE(12,81)
     *            ANODE,LEGA,BNODE,LEGB,IUTMA,IUTMB,IUTMC,IUTMD,
     * STATEN,CTYN ,GRIDNO,(RTNAME(J),J=1,5),(CRSSTA(J),J=1,5),
     *           (CRSSTB(J),J=1,5),LNKNO ,
     * IDIS,ADT,IPKHR,AVDIR,AMAXHR,AVTIME,AVVOL,BVDIR,BMAXHR,BVTIME,
     * BVVOL,       ADASPD,AMPKSP,AMDIR,PMPKSP,PMDIR,
     * ACPACT,BCPACT,TRUKVL,
      *                ITRUCK,BLSVL,IBUSP,SPTEPL,CPALTL,SEKLUL,
      * ACTENT, PROMOL,CHANAL,FCLSSL
 81   FORMAT(I5,I1,I5,I1,4I5  ,I1,I2,I5,5A4,5A4,
      *        5A4,I6,I4  ,I6,I2  ,I2,I4,I1,I4,I2,I4,I1,I4,4X,2X,I2,I2,
      * I1,I2,I1,6X,
      *        I5,I5,I4,I2  ,I4,I2  ,7I1)
       ISAVE1=ISAVE1+1
       SAVE1=SAVE1+LDIS
       VKT(FCLSSL)=VKT(FCLSSL)+(ADT*LDIS)
       GO TO 27
 900   CONTINUE
C*******************************************************************************
C        PRINT TOTALS OF VKT BY FUNCTIONAL CLASS.
C*******************************************************************************
       WRITE(6,910) ISAVE1,GRIDTN,SAVE1
 910   FORMAT('0',  10X,'THERE ARE',I8,' LINKS IN GRID NUMBER',I8,
      * /12X,'THESE LINKS ACCOUNT FOR ',F8.2,' KILOMETERS OF ROADWAY')
       VKTT=VKT(1)+VKT(2)+VKT(3)+VKT(4)+VKT(5)
       WRITE(6,920)VKTT
 920   FORMAT(/  12X,'THERE ARE ',F10.2,' VEHICLE KILOMETERS ',
      *  'TRAVELED (VKT) IN THIS GRID')
       WRITE(6,930)  (VKT(J),J=1,5)
 930   FORMAT(/ 20X,'FREEWAY VKT = ', F10.2, /
      * 20X,'PRINCIPLE ARTERIAL VKT = ',F10.2 ,/
      * 20X,'MINOR ARTERIAL VKT = ', F10.2, /
      * 20X, 'COLLECTOR VKT = ', F10.2,/
      * 20X, 'LOCAL VKT = ', F10.2)
       GO TO 15
 1000  CONTINUE
       REWIND4
C*******************************************************************************
C        PRINT END OF OUTPUT FROM GRIDRT.
C*******************************************************************************
       WRITE(6,1010)
 1010  FORMAT('1',10X,'END OF OUTPUT FROM SUBROUTINE GRIDRT')
C*******************************************************************************
C        END OF SUBROU/INE GRIDRT.
C*******************************************************************************
       RETURN
       END
```

```
0001                SUBROUTINE LINKRT
             C**********************************************************************
             C
             C         SUBROUTINE LINKRT TESTS FOR SPECIFIC LINK RECORDS FROM
             C         THE ROADWAY DATA FILE.
             C
             C**********************************************************************
             C**********************************************************************
             C         INITIALIZE VARIABLES.
             C**********************************************************************
0002                INTEGER LINKTN
0003                INTEGER ANODE,LEGA,BNODE,LEGB,STATEN,CTYN ,BRIDNC
0004                INTEGER LNKNO,ADT,AVDIR,AMAXHR,AVTIME,AVVEL,AVCIR,BMAXHR,BVTIM
                   * BVVOL,       ADASPD,APPKSP,APDIR,BPPKSP,BPDIR
0005                INTEGER ACPACT,BCPACT,TRUKVL,BUSVL,SPTCPL,CPALTL,SPKLUL,ACTCNT
                   * PRGPCL,CHANAL,FCLSSL
0006                REAL UTMAX,UTMAY,UTMBX,UTMBY
0007                REAL LOIS,PKHRP
0008                REAL TRUKPC,BUSPC
0009                DIMENSION RTNAME(5),CRSSTA(5),CRSSTR(5)
0010                DATA YES/'YES'/
0011                SAVE2=0
0012                ISAVE2=0
0013                SAVE3=0
             C**********************************************************************
             C         INITIALIZE READER DEVICE FOR ROADWAY INVENTORY FILE.
             C**********************************************************************
0014                ISW=8
             C**********************************************************************
             C         PRINT BEGINNING OF OUTPUT FROM LINKRT.
             C**********************************************************************
0015                WRITE(6,10)
0016         10     FORMAT('1',10X,'OUTPUT FROM SUBROUTINE LINKRT FOLLOWS' /////)
             C**********************************************************************
             C         READ LINK TEST CONTROL CARD.
             C**********************************************************************
0017         15     READ(5,25)LINKTN,FORM
0018         25     FORMAT(I5,A3)
             C**********************************************************************
             C         TEST FOR THE END OF THE LINK TEST CONTROL CARD FILE.
             C**********************************************************************
0019                IF(LINKTN.EQ.99999)GO TO 1000
             C**********************************************************************
             C         READ RECORD FROM ROADWAY INVENTORY FILE.
             C**********************************************************************
0020         27     READ(ISW,30,END=1000)
                   *             ANODE,LEGA,BNODE,LEGB,UTMAX,UTMAY,UTMBX,UTMBY,
                   * STATEN,CTYN ,BRIDNC,(RTNAME(J),J=1,5),(CRSSTA(J),J=1,5),
      C************************************************************************
      15    READ(5,25)LINKTN,FORM
      25    FORMAT(I5,A3)
      C************************************************************************
      C          TEST FOR THE END OF THE LINK TEST CONTROL CARD FILE.
      C************************************************************************
            IF(LINKTN.EQ.99999)GO TO 1000
      C************************************************************************
      C          READ RECORD FROM ROADWAY INVENTORY FILE.
      C************************************************************************
      27    READ(ISW,30,END=1000)
           *              ANODE,LEGA,BNODE,LEGB,UTMAX,UTMAY,UTMBX,UTMBY,
           * STATEN,CTYN ,ORIDNO,(RTNAME(J),J=1,5),(CRSSTA(J),J=1,5),
           *              (CRSSTB(J),J=1,5),LNKNO ,
           * LDIS,ADT,PKHRP,AVDIR,APAKHR,AVTIME,AVVOL,BVDIR,BPAKHR,BVTIME,
           * BVVOL,       ADASPD,AMPKSP,APDIR,BPPKSP,BPDIR,
           * ACPACT,BCPACT,TRUKVL,
           *                  TRUKPC,BUSVL,BUSPC,SPTCPL,CPALTL,SENLUL,
           * ACTCNT, PROMOL,CHANAL,FCLSSL
      30    FORMAT(I5,I1,I5,I1,4F5.1,I1,I2,I5,5A4,5A4,
           *       5A4,I6,F4.2,I6,F2.2,I2,I4,I1,I4,I2,I4,I1,I4,4X,2X,I2,I2,
           * I1,I2,I1,6X,
           *       I4,I5,I4,F2.2,I4,F2.2,7I1)
      C************************************************************************
      C          TEST IF LINK IS LINK TO BE TESTED FOR.
      C************************************************************************
            IF(LINKTN.EQ.LNKNO)GO TO 50
            GO TO 27
      C************************************************************************
      C          WRITE LINK THAT PASSED EQUALITY TEST.
      C************************************************************************
      50    IF(FORM.EQ.YES) GO TO 52
            WRITE(6,51)LNKNO,(RTNAME(J),J=1,5),(CRSSTA(J),J=1,5),
           * (CRSSTB(J),J=1,5)
      51    FORMAT(' ',2X,I6,2X,5A4,2X,5A4,2X,5A4)
            GO TO 53
      52    CALL NPRINT
      53    ISAVE2=ISAVE2+1
            IUTMA=UTMAX*10
            IUTMB=UTMAY*10
            IUTMC=UTMBX*10
            IUTMD=UTMBY*10
            IDIS=LDIS*100
            IPKHR=PKHRP*100
            ITRUCK=TRUKPC*100
            IBUSP=BUSPC*100
            WRITE(12,81)
           *              ANODE,LEGA,BNODE,LEGB,IUTMA,IUTMB,IUTMC,IUTMD,
     * STATEN,CTYN ,ORIGND,(RTNAME(J),J=1,5),(CRSSTA(J),J=1,5),
     *          (CRSSTB(J),J=1,5),LNKNO ,
     * IDIS,ADT,IPKHR,AVDIR,APAXHR,AVTIPE,AVVEL,BVDIR,BPAXHR,BVTIPE,
     * BVVEL,       ADASPD,AMPKSP,AMDIR,PPPKSP,PMDIR,
     * ACPACT,BCPACT,TRUKVL,
     *                ITRUCK,BUSVL,IBUSP,SPTOPL,CPALTL,SENLUL,
     * ACTCNT, PROMOL,CHANAL,FCLSSL
 81   FORMAT(I5,I1,I5,I1,4I5  ,I1,I2,I5,5A4,5A4,
     *        5A4,I6,I4  ,I6,I2  ,I2,I4,I1,I4,I2,I6,I1,I4,4X,2X,I2,I2,
     * I1,I2,I1,6X,
     *        I5,I5,I4,I2  ,I4,I2  ,7I1)
      SAVE2=SAVE2+LDIS
      SAVE3=SAVE3+(ADT*LDIS)
      GO TO 15
 1000 CONTINUE
C*****************************************************************************
C         PRINT END OF OUTPUT FROM LINKRT.
C*****************************************************************************
      WRITE(6,1002) ISAVE2,SAVE2,SAVE3
 1002 FORMAT(/////10X,'THERE ARE ',I8,' LINKS TESTED IN THIS SUBROUTINE
     * ',/ 12X,'THESE LINKS ACCOUNT FOR ',F8.2,' KILOMETERS OF ROADWAY'
     */12X,'THESE LINKS ACCOUNT FOR ',F12.2,' VEHICLE ',
     * 'KILOMETERS TRAVELED (VKT)')
      WRITE(6,1010)
 1010 FORMAT('1',10X,'END OF OUTPUT FROM SUBROUTINE LINKRT')
C*****************************************************************************
C         END OF SUBROUTINE LINKRT.
C*****************************************************************************
      REWIND4
      RETURN
      END
      SUBROUTINE NETSRT
C*****************************************************************************
C
C         SUBROUTINE NETSRT PERFORMS A SERIES OF SEQUENTIAL TESTS OF
C         PRESENCE OF NETWORK RELATED ATTRIBUTES.  THE TESTS TO
C         BE USED ARE SPECIFIED BY THE USER ON THE CONTROL CARD.
C
C*****************************************************************************
C*****************************************************************************
C         INITIALIZE VARIABLES.
C*****************************************************************************
      INTEGER ANODE,LEGA,BNODE,LEGB,STATEN,CTYN ,GRIDAC
      INTEGER LNKNO,ADT,AVDIR,AMAXHR,AVTIME,AVVOL,BVDIR,BMAXHR,BVTIME,
     * BVVOL,      ADASPD,AMPKSP,AMDIR,BMPKSP,BMDIR
      INTEGER ACPACT,BCPACT,TRUKVL,BUSVL,SPTOPL,CPALTL,SENLUL,ACTCNT,
     * PROMCL,CHANAL,FCLSSL
      REAL UTMAX,UTMAY,UTMBX,UTMBY
      REAL LDIS,PKHRP
      REAL TRUKPC,BUSPC
      DIMENSION RTNAME(5),CRSSTA(5),CRSSTB(5)
      INTEGER ADTLW,ADTHI,STATEC(3),CTYNO(13), SPTCPC(5),CPALTC(6),
     * SENLUC(8),ACTCNC(6)
      REAL XSUB1,XSUB2,YSUB1,YSUB2
      INTEGER PROMOC(5),CHANAC(2),FCLSSC(6),          PKSPDH,
     * PKSPDL,TRKVHI,TRKVLW,BUSHI,BUSLW
      REAL LDISH,LDISL,VOCHI,VOCLW
C*****************************************************************************
C         PRINT BEGINNING OF OUTPUT FROM NETSRT.
C*****************************************************************************
      WRITE(6,10)
10    FORMAT('1',10X,'OUTPUT FROM SUBROUTINE NETSRT FOLLOWS:')
C*****************************************************************************
C         INITIALIZE READER DEVICE FOR ROADWAY INVENTORY FILE.
C*****************************************************************************
      ISC=5
      ISW=4
C*****************************************************************************
C         READ IN CONTROL CARD
C*****************************************************************************
11    SAVE3=0
      ISAVE3=0
      SAVE4=0
      READ(ISC,25,END=1000)CC4,ADTLW,ADTHI,XSUB1,XSUB2,YSUB1,YSUB2,
     * (STATEC(J),J=1,3),(CTYNO(J),J=1,13),(SPTCPC(J),J=1,5),
     * (CPALTC(J),J=1,6), (SENLUC(J),J=1,8), (ACTCNC(J),J=1,6)
25    FORMAT(A3,I6,I6,4F5.1,41I1,4X)
      READ(ISC,26) (PROMOC(J),J=1,5), (CHANAC(J),J=1,2),(FCLSSC(J),
     * J=1,6), LDISH,LDISL,PKSPDH,PKSPDL,TRKVHI,TRKVLW,
     * BUSHI,BUSLW,VOCHI,VOCLW
26    FORMAT(13I1,2F4.2,2I2,2I4,2I3,2F3.2)
C*******************************************************************************
C          INITIALIZE VARIABLES USED IN PRINTING WHAT IS ANC IS NCT TESTE
C*******************************************************************************
      A=1
      B=0
C*******************************************************************************
C          WRITING THOSE LINK PARAMETERS TESTED FCR.
C*******************************************************************************
      WRITE(6,14)
14    FORMAT('1',/////2X,'THE FOLLOWING LINK CHARACTERISTIC(S) TESTEC '
     * , 'FOR.'///)
15    IF(A.EQ.1.AND.ADTHI.NE.0) GO TO 16
      IF(A.NE.1.AND.ADTHI.EQ.0) GO TO 16
      GO TO 17
16    PRINT 500,ADTLW,ADTHI
17    IF(XSUB1+XSUB2+YSUB1+YSUB2.EQ.0.AND.A.EQ.1 ) GC TO 19
      IF(XSUB1+XSUB2+YSUB1+YSLR2.NE.0.AND.A.EG.0) GC TO 19
      GO TO 18
18    PRINT 501,XSUB1,XSUB2,YSUB1,YSUB2
19    IF(STATEC(1).EQ.A) PRINT 505
      IF(STATEC(2).EQ.A) PRINT 506
      IF(STATEC(3).EQ.A) PRINT 507
      IF(CTYNO(1).EQ.A) PRINT 510
      IF(CTYNO(2).EQ.A) PRINT 511
      IF(CTYNO(3).EQ.A) PRINT 512
      IF(CTYNO(4).EQ.A) PRINT 513
      IF(CTYNO(5).EQ.A) PRINT 514
      IF(CTYNO(6).EQ.A) PRINT 515
      IF(CTYNO(7).EQ.A) PRINT 516
      IF(CTYNO(8).EQ.A) PRINT 517
      IF(CTYNO(9).EQ.A) PRINT 518
      IF(CTYNO(10).EQ.A)  PRINT 519
      IF(CTYNO(11).EQ.A) PRINT 520
      IF(CTYNO(12).EQ.A) PRINT 521
      IF(CTYNO(13).EQ.A) PRINT 522
      IF(SPTOPC(1).EQ.A) PRINT 530
      IF(SPTOPC(2).EQ.A) PRINT 531
      IF(SPTOPC(3).EQ.A) PRINT 532
      IF(SPTOPC(4).EQ.A) PRINT 533
      IF(SPTOPC(5).EQ.A) PRINT 534
      IF(CPALTC(1).EQ.A)  PRINT 540
      IF(CPALTC(2).EQ.A) PRINT 541
      IF(CPALTC(3).EQ.A) PRINT 542
      IF(CPALTC(4).EQ.A) PRINT 543
      IF(CPALTC(5).EQ.A) PRINT 544
      IF(CPALTC(6).EQ.A) PRINT 545
      IF(SENLUC(1).EQ.A) PRINT 560
      IF(SENLUC(2).EQ.A) PRINT 561
      IF(SENLUC(3).EQ.A) PRINT 562
      IF(SENLUC(4).EQ.A) PRINT 563
      IF(SENLUC(5).EQ.A) PRINT 564
      IF(SENLUC(6).EQ.A) PRINT 565
      IF(SENLUC(7).EQ.A) PRINT 566
      IF(SENLUC(8).EQ.A) PRINT 567
      IF(ACTCNG(1).EQ.A) PRINT 570
      IF(ACTCNG(2).EQ.A) PRINT 571
      IF(ACTCNG(3).EQ.A) PRINT 572
      IF(ACTCNG(4).EQ.A) PRINT 573
      IF(ACTCNG(5).EQ.A) PRINT 574
      IF(ACTCNG(6).EQ.A) PRINT 575
      IF(PROMOC(1).EQ.A) PRINT 580
      IF(PROMOC(2).EQ.A) PRINT 581
      IF(PROMOC(3).EQ.A) PRINT 582
      IF(PROMOC(4).EQ.A) PRINT 583
      IF(PROMOC(5).EQ.A) PRINT 584
      IF(CHANAC(1).EQ.A) PRINT 590
      IF(CHANAC(2).EQ.A) PRINT 591
      IF(FCLSSC(1).EQ.A) PRINT 600
      IF(FCLSSC(2).EQ.A) PRINT 601
      IF(FCLSSC(3).EQ.A) PRINT 602
      IF(FCLSSC(4).EQ.A) PRINT 603
      IF(FCLSSC(5).EQ.A) PRINT 604
      IF(FCLSSC(6).EQ.A) PRINT 605
      IF(A.EQ.1.AND.LDISH.NE.C) GO TO 28
      IF(A.NE.1.AND.LDISH.EQ.0) GO TO 28
      GO TC 30
 28   PRINT 610, LDISL,LDISH
 30   IF(A.EQ.1.AND.PKSPDH.NE.0) GO TO 35
      IF(A.NE.1.AND.PKSPDH.EQ.0) GO TO 35
      GO TC 40
 35   PRINT 620, PKSPDL, PKSPDH
 40   IF(A.EQ.1.AND.TRKVHI.NE.0) GO TO 45
      IF(A.NE.1.AND.TRKVHI.EQ.0) GO TO 45
      GO TC 50
 45   PRINT 630, TRKVLW,TRKVHI
 50   IF(A.EQ.1.AND.BUSHI.NE.C) GO TO 55
      IF(A.NE.1.AND.BUSHI.EQ.0) GO TO 55
      GO TC 60
 55   PRINT 640, BUSLW, BUSHI
 60   IF(A.EQ.1.AND.VOCHI.NE.C) GO TO 65
      IF(A.NE.1.AND.VOCHI.EQ.0) GO TO 65
      GO TC 70
 65   PRINT 650, VOCLW, VOCHI
 70   CONTINUE
```

```
71    FORMAT(///'   THE FOLLOWING LINKS PASSED TESTS'//)
      IF(A.EQ.1) GO TO 72
      PRINT 71
      GO TO 75
C************************************************************************
C        WRITING THOSE LINK PARAMETERS NOT TESTED FOR.
C************************************************************************
72    WRITE(6,73)
73    FORMAT('-',////2X,'THE FOLLOWING LINK CHARACTERISTIC(S) NOT TESTED
     * FOR.'//)
      A=0
      GO TO 15
C************************************************************************
C        READING RECORD FROM ROADWAY INVENTORY FILE.
C************************************************************************
75    READ(ISW,82,END=250) ANODE,LEGA,BNODE,LEGB,UTMAX,UTMAY,UTMBX,
     * UTMBY,STATEN,CTYN,GRIDNO,
     * (RTNAME(J),J=1, 5),(CRSSTA(J),J=1, 5),
     *               (CRSSTB(J),J=1, 5),
     *                          LNKNO,LDIS,ADT,PKHRF,AVDIR,AMAXHR,AVTIME,
     * AVVOL,BVDIR,BMAXHR,BVTIME,BVVOL,       ADASPC,AMPKSP,AMDIR,
     * PMPKSP,PMDIR,
     *               ACPACT,DCPACT,TRUKVL,TRUKPC,BUSVL,BUSPC,SPTCFL,
     * CPALTL,SENLUL,ACTCNT,PROMOL,CHANAL,FCLSSL
82    FORMAT(I5,I1,I5,I1,4F5.1,I1,I2,I5,5A4,5A4,
     *         5A4,I6,F4.2,I6,F2.2,I2,I4,I1,I4,I2,I4,I1,I4,4X,2X,I2,I2,
     * I1,I2,I1,6X,
     *         I5,I5,I4,F2.2,I4,F2.2,7I1)
C************************************************************************
C         INITIALIZE VARIABLES.
C************************************************************************
      ISTATE=0
      ICTYNO=0
      ISPTCF=0
      ICPALT=0
      ISENLU=0
      IACTCN=0
      IPROMO=0
      ICHANA=0
      IFCLSS=0
      ISPDPD=0
C************************************************************************
C  TESTING FOR ADT.
C************************************************************************
100   IF(ADTHI.EQ.0) GO TO 105
      IF(ADT.GE.ADTLW.AND.ADT.LE.ADTHI) GO TO 105
      GO TO 75
C************************************************************************
```

```
      C  TESTING FOR COORDINATES.
      C**********************************************************************
      105    IF(XSUB1+XSUB2+YSUB1+YSUB2.EQ.0) GO TO 110
             IF(UTMAX.LT.XSUB1.OR.UTMAX.GT.XSUB2) GO TO 75
             IF(UTMRX.LT.XSUB1.OR.UTMRX.GT.XSUB2) GO TO 75
             IF(UTMAY.LT.YSUB1.OR.UTMAY.GT.YSUB2) GO TO 75
             IF(UTMRY.LT.YSUB1.OR.UTMRY.GT.YSUB2) GO TO 75
             GO TO 110
      C**********************************************************************
      C  TESTING FOR STATE.
      C**********************************************************************
      110    STATEN=STATEN+1
             DO 111 J=1,3
      111    ISTATE=ISTATE+STATEC(J)
             IF(ISTATE.EQ.0) GO TO 115
             IF(STATEC(STATEN).EQ.1) GO TO 115
             GO TO 75
      C**********************************************************************
      C  TESTING FOR COUNTY.
      C**********************************************************************
      115    CTYN=CTYN+1
             DO 116 J=1,13
      116    ICTYNO=ICTYNO+CTYNO(J)
             IF(ICTYNO.EQ.0) GO TO 120
             IF(CTYNO(CTYN).EQ.1) GO TO 120
             GO TO 75
      C**********************************************************************
      C  TESTING FOR SPECIAL TOPOGRAPHY.
      C**********************************************************************
      120    SPTOPL=SPTOPL+1
             DO 121 J=1,5
      121    ISPTOP=ISPTOP+SPTOPC(J)
             IF(ISPTOP.EQ.0) GO TO 125
             IF(SPTOPC(SPTOPL).EQ.1) GO TO 125
             GO TO 75
      C**********************************************************************
      C  TESTING FOR CAPACITY ALTERATIONS.
      C**********************************************************************
      125    CPALTL=CPALTL+1
             DO 126 J=1,6
      126    ICPALT=ICPALT+CPALTC(J)
             IF(ICPALT.EQ.0) GO TO 130
             IF(CPALTC( CPALTL).EQ.1) GO TO 130
             GO TO 75
      C**********************************************************************
      C  TESTING FOR SENSITIVE LAND USE.
      C**********************************************************************
      130    SENLUL=SENLUL+1
      DO 131 J=1,8
131   ISENLU=ISENLU+SENLUC(J)
      IF(ISENLU.EQ.0) GO TO 135
      IF(SENLUC(SENLUL).EQ.1) GO TO 135
      GO TO 75
C***********************************************************************
C  TESTING FOR ACTIVITY CENTERS.
C***********************************************************************
135   ACTCNT=ACTCNT+1
      DO 136 J=1,6
136   IACTCN=IACTCN+ACTCNC(J)
      IF(IACTCN.EQ.0) GO TO 140
      IF(ACTCNC(ACTCNT).EQ.1) GO TO 140
      GO TO 75
C***********************************************************************
C  TESTING FOR PROGRESSIVE MOVEMENT.
C***********************************************************************
140   PROMOL=PROMOL+1
      DO 141 J=1,5
141   IPROMO=IPROMO+PROMOC(J)
      IF(IPROMO.EQ.0) GO TO 145
      IF(PROMOC(PROMOL).EQ.1) GO TO 145
      GO TO 75
C***********************************************************************
C  TESTING FOR CHANNELIZATION.
C***********************************************************************
145   CHANAL=CHANAL+1
      DO 146 J=1,2
146   ICHANA=ICHANA+CHANAC(J)
      IF(ICHANA.EQ.0) GO TO 150
      IF(CHANAC(CHANAL).EQ.1) GO TO 150
      GO TO 75
C***********************************************************************
C  TESTING FOR FUNCTIONAL CLASS.
C***********************************************************************
150   FCLSSL=FCLSSL+1
      DO 151 J=1,6
151   IFCLSS=IFCLSS+FCLSSC(J)
      IF(IFCLSS.EQ.0) GO TO 155
      IF(FCLSSC(FCLSSL).EQ.1) GO TO 155
      GO TO 75
 155  CONTINUE
C***********************************************************************
C  TESTING FOR DISTANCE.
C***********************************************************************
160   IF(LDISH.EQ.0) GO TO 165
      IF(LDIS.GE.LDISL.AND.LDIS.LE.LDISH) GO TO 165
      GO TO 75
```

```
C***********************************************************************
C  TESTING FOR SPEED DIFFERENCE OF AVERAGE DAILY SPEED MINUS
C          PEAK SPEED.
C***********************************************************************
165   ISPEED=ADASPD-APPKSP
      IF(PKSPDH.EQ.0) GO TO 175
      IF(ISPEED.LE.PKSPDH.AND.ISPEED.GE.PKSPDL) GO TO 170
      GO TO 75
170   JSPEED=ADASPD-PPPKSP
      IF(JSPEED.LE.PKSPDH.AND.JSPEED.GE.PKSPDL) GO TO 175
      GO TO 75
C***********************************************************************
C  TESTING FOR TRUCK VOLUMES.
C***********************************************************************
175   IF(TRKVHI.EQ.0) GO TO 185
      IF(TRUKVL.EQ.0) GO TO 180
      IF(TRUKVL.LE.TRKVHI.AND.TRUKVL.GE.TRKVLW) GO TO 185
      GO TO 75
180   IF(TRUKPC*ADT.LE.TRKVHI.AND.TRUKPC*ADT.GE.TRKVLW)GO TO 185
      GO TO 75
C***********************************************************************
C  TESTING FOR BUS VOLUMES.
C***********************************************************************
185   IF(BUSHI.EQ.0) GO TO 195
      IF(BUSVL.EQ.0) GO TO 190
      IF(BUSVL.LE.BUSHI.AND.BUSVL.GE.BUSLW) GO TO 195
      GO TO 75
190   IF(BUSPC*ADT.LE.BUSHI.AND.BUSPC*ADT.GE.BUSLW) GO TO 195
      GO TO 75
C***********************************************************************
C  TESTING FOR V OVER C.
C***********************************************************************
195   IF(VOCHI.EQ.0) GO TO 225
      IF(ACPACT.EQ.0.AND.AVVOL.EQ.0) GO TO 75
      IF(ACPACT.EQ.0)      GO TO 199
      IF(AVDIR.EQ.25) GO TO 196
      IF(AVVOL.EQ.0)AVVOL=PKHRP*ADT/2
      IF(AVVOL.EQ.0.AND.PKHRP.EQ.0)AVVOL=.1*ADT/2
      SAVEA=FLOAT(AVVOL)/FLOAT(ACPACT)
      IF(SAVEA.LE.VOCHI.AND.SAVEA.GE.VOCLW) GO TO 205
      GO TO 75
196   SAVEA=FLOAT(AVVOL)/FLOAT(ACPACT)
      IF(SAVEA.LE.VOCHI.AND.SAVEA.GE.VOCLW) GO TO 225
      GO TO 75
197   FORMAT(' ',5X,I5,5X,I5,'***ERROR***',' DIVISION BY ZERO ATTEMPTE
     *D')
C***********************************************************************
C        DIVISION BY ZERO ERROR ROUTINE.
```

```
C*************************************************************************
199   PRINT 197,LNKNO
      GO TO 75
205   IF(BCPACT.EQ.0.AND.BVVOL.EQ.0) GO TO 75
      IF(BCPACT.EQ.0) GO TO 199
      IF(BVVOL.EQ.0) BVVOL=PKHRP*ADT/2
      IF(BVVOL.EQ.0.AND.PKHRP.EQ.0) BVVOL=.1*ADT/2
      SAVER=FLOAT(BVVOL)/FLOAT(BCPACT)
      IF(SAVER.LE.VOCHI.AND.SAVER.GE.VOCLW) GO TO 225
      GO TO 75
C*************************************************************************
C        WRITING THOSE LINKS THAT PASSED.
C*************************************************************************
225   WRITE(6,230) LNKNO,(RTNAME(J),J=1,5),(CRSSTA(J),J=1,5),
     * (CRSSTB(J),J=1,5),ADT,LDIS
230   FORMAT(' ',I6,4X,5A4,4X,5A4,4X,5A4,2X,I7,2X,F6.2)
      IUTMA=UTMAX*10
      IUTMB=UTMAY*10
      IUTMC=UTMBX*10
      IUTMD=UTMBY*10
      IDIS=LDIS*100
      IPKHR=PKHRP*100
      ITRUCK=TRUKPC*100
      IBUSP=BUSPC*100
      WRITE(12,241)
     *          ANODE,LEGA,BNODE,LEGB,IUTMA,IUTMB,IUTMC,IUTMD,
     *      STATEN,CTYN,GRIDNO,
     * (RTNAME(J),J=1, 5),(CRSSTA(J),J=1, 5),
     *          (CRSSTB(J),J=1, 5),LNKNO,
     * IDIS,ADT,IPKHR,AVDIR,AMAXHR,AVTIME,AVVOL,BVDIR,BMAXHR,BVTIME,
     *                          BVVOL,      ADASPC,AMPKSP,AMDIR,
     * PMPKSP,PMDIR,
     *          ACPACT,BCPACT,TRUKVL,ITRUCK,BUSVL,IBUSP,SPTCFL,
     * CPALTL,SENLUL,ACTGNT,PROMOL,CHANAL,FCLSSL
241   FORMAT(I5,I1,I5,I1,4I5  ,I1,I2,I5,5A4,5A4,
     *      5A4,I6,I4  ,I6,I2  ,I2,I4,I1,I4,I2,I4,I1,I4,4X,2X,I2,I2,
     * I1,I2,I1,6X,
     *      I5,I5,I4,I2  ,I4,I2  ,7I1)
      ISAVE3=ISAVE3+1
      SAVE3=SAVE3+LDIS
      SAVE4=SAVE4+(ADT*LDIS)
      GO TO 75
251   REWIND 4
      WRITE(6,255) ISAVE3,SAVE3
255   FORMAT(/////10X,'THERE ARE ',I8,' LINKS THAT MEET THE ABOVE '
     *,'PARAMETERS TESTED'/ 12X,'THESE LINKS ACCOUNT FOR ',F8.2,
     * ' KILOMETERS OF ROADWAY')
      WRITE(6,260) SAVE4
```

```
260   FORMAT(/ 12X,'THESE LINKS ACCOUNT FOR ',F12.2,' VEHECLES '
     * ,'KILOMETERS TRAVELED (VKT)')
      GO TO 11
1000  CONTINUE
C***********************************************************************
C        PRINT END OF OUTPUT FROM NETSRT.
C***********************************************************************
      WRITE(6,1010)
1010  FORMAT('1',10X,'END OF OUTPUT FROM SUBROUTINE NETSRT')
C***********************************************************************
C        FORMATING FOR PARAMETERS TO BE AND NOT TO BE TESTED FOR.
C***********************************************************************
500   FORMAT('      ADTHI: AVE.DAILY TRAFFIC',5X,I7,' TO ',I7)
501   FORMAT('      XSUB1= ',F5.1,2X,'XSUB2= ',F5.1,5X,'YSUB1= ',
     * F7.1,2X,'YSUB2= ',F7.1)
505   FORMAT('      STATEC(1): TEST FOR NOT PRESENT')
506   FORMAT('      STATEC(2): TEST FOR MISSOURI')
507   FORMAT('      STATEC(3): TEST FOR ILLINOIS')
510   FORMAT('      CTYNO(1): TEST FOR UNKNOWN')
511   FORMAT('      CTYNO(2): TEST FOR ST. LOUIS CITY')
512   FORMAT('      CTYNO(3): TEST FOR ST. LOUIS COUNTY')
513   FORMAT('      CTYNO(4): TEST FOR ST. CHARLES COUNTY')
514   FORMAT('      CTYNO(5): TEST FOR JEFFERSON COUNTY')
515   FORMAT('      CTYNO(6): TEST FOR FRANKLIN COUNTY')
516   FORMAT('      CTYNO(7): TEST FOR BOND COUNTY')
517   FORMAT('      CTYNO(8): TEST FOR CLINTON COUNTY')
518   FORMAT('      CTYNO(9): TEST FOR MADISON COUNTY')
519   FORMAT('      CTYNO(10): TEST FOR MONROE COUNTY')
520   FORMAT('      CTYNO(11): TEST FOR RANDOLPH COUNTY')
521   FORMAT('      CTYNO(12): TEST FOR ST. CLAIR COUNTY')
522   FORMAT('      CTYNO(13): TEST FOR WASHINGTON COUNTY')
530   FORMAT('      SPTOPC(1): TEST FOR NOT PRESENT')
531   FORMAT('      SPTOPC(2): TEST FOR DEEP CUT')
532   FORMAT('      SPTOPC(3): TEST FOR HIGH FILL')
533   FORMAT('      SPTOPC(4): TEST FOR STREET CANYON')
534   FORMAT('      SPTOPC(5): TEST FOR ROLLING TOPOGRAPHY')
540   FORMAT('      CPALTC(1): TEST FOR NOT PRESENT')
541   FORMAT('      CPALTC(2): TEST FOR COMPLEX INTERCHANGE')
542   FORMAT('      CPALTC(3): TEST FOR LANE REDUCTIONS')
543   FORMAT('      CPALTC(4): TEST FOR BOTTLENECKS')
544   FORMAT ('      CPALTC(5): TEST FOR LANE REDUCTIONS AND '
     * ,'BOTTLENECKS')
545   FORMAT('      CPALTC(6): TEST FOR COMPLEX INTERCHANGES AND '
     * ,'BOTTLENECKS')
560   FORMAT('      SENLUC(1): TEST FOR NOT PRESENT')
561   FORMAT('      SENLUC(2): TEST FOR COMMERCIAL DEVELOPMENT')
562   FORMAT('      SENLUC(3): TEST FOR INDUSTRIAL DEVELOPMENT')
563   FORMAT('      SENLUC(4): TEST FOR RECREATIONAL DEVELOPMENT')
```

```
  564   FORMAT('      SENLUC(5): TEST FOR HOSPITAL')
  565   FORMAT('      SENLUC(6): TEST FOR UNIVERSITY OR COLLEGE')
  566   FORMAT('      SENLUC(7): TEST FOR AIRPORT DEVELOPMENT')
  567   FORMAT('      SENLUC(8): TEST FOR MULTI-FAMILY DEVELOPMENT')
  570   FORMAT('      ACTCNC(1): TEST FOR NOT PRESENT')
  571   FORMAT ('      ACTCNC(2): TEST FOR CENTRAL BUSINESS DISTRICT')
  572   FORMAT('      ACTCNC(3): TEST FOR FRINGE AREA')
  573   FORMAT('      ACTCNC(4): TEST FOR OUTLYING BUSINESS DISTRICT')
  574   FORMAT('      ACTCNC(5): TEST FOR RESIDENTIAL AREA')
  575   FORMAT('      ACTCNC(6): TEST FOR RURAL AREA')
  580   FORMAT('      PROMOC(1): TEST FOR NOT PRESENT')
  581   FORMAT('      PROMOC(2): TEST FOR PRE-TIMED PROGRESSIVE')
  582   FORMAT('      PROMOC(3): TEST FOR INTERCONNECTED PROGRESSIVE '
       * ,'SIGNALS')
  583   FORMAT('      PROMOC(4): TEST FOR ONE-WAY STREET FLOW WITHOUT ',
       * 'SIGNAL PROGRESSION')
  584   FORMAT('      PROMOC(5): TEST FOR ONE-WAY STREET FLOW WITH ',
       *  'SIGNAL PROGRESSION')
  590   FORMAT('      CHANAC(1): TEST FOR NO CHANNELIZATION')
  591   FORMAT('      CHANAC(2): TEST FOR CHANNELIZATION')
  600   FORMAT('      FCLSSC(1): TEST FOR NOT PRESENT')
  601   FORMAT('      FCLSSC(2): TEST FOR FREEWAY')
  602   FORMAT('      FCLSSC(3): TEST FOR PRINCIPLE ARTERIAL')
  603   FORMAT('      FCLSSC(4): TEST FOR MINOR ARTERIAL')
  604   FORMAT('      FCLSSC(5): TEST FOR COLLECTOR')
  605   FORMAT('      FCLSSC(6): TEST FOR LOCAL')
  610   FORMAT('      DISTANCE OF LINK',5X,F6.2,'  TO  ',F6.2)
  620   FORMAT('      PEAK SPEED',5X,I6,'  TO  ',I6)
  630   FORMAT('      TRUCK VOLUME' ,5X,I6,' TO ',I6)
  640   FORMAT('      BUS VOLUME', 5X,I6,' TO ', I6)
  650   FORMAT('      V OVER C, PEAK ', 5X,F6.2,'  TO  ',F6.2)
C**********************************************************************
C        END OF SUBROUTINE NETSRT.
C**********************************************************************
        RETURN
        END
```

APPENDIX B. ECOMP: COMPUTER PROGRAM DOCUMENTATION

Program Documentation for Program ECOMP

A. Purpose - This program is designed to estimate emissions from all types of vehicles on arterial and freeway line sources using emission factors from the Modal Emissions program and AP-42 Supplement 5 for various monitoring periods. In addition it will add line source emissions to EPA grid totals.

B. Inputs

1. Control Card 1 specifies the V/C range, ADT range, and functional class of the input line sources. These are shown in Figure B-1. In addition it specifies how many hours of emissions are to be computed, the assumed truck percentage, and whether or not the emission totals are to be added to grid totals on a disk data set.

2. Control Card 2 specifies the particular hours for which emissions are desired.

C. Outputs

1. The program prints out a summary about each line source processed including UTM coordinates of the nodes, EPA grid number, traffic volume, and hour under consideration.

2. Optionally, the program will take the emissions from any line source and add them to the total for the appropriate EPA grid and write this back out on a disk storage device. In this way the AQCR grid totals for line sources can be accumulated.

D. Operation

The program begins by reading in the control cards specifying the types of line sources to be expected and the hours of the day for which

Variable Name	Implied Value
IFCL	1 = Freeway
	2 = Principal Arterial
	3 = Minor Arterial
IVCR	1 = < .3
	2 = .3 - .6
	3 = .6 - .9
	4 = > .9
IADT	
FWY	1 = 0 - 40 K
	2 = 40 - 60 K
	3 = 60 - 80 K
	4 = > 80 K
P. Art.	1 = 0 - 10 K
	2 = 10 - 20 K
	3 = 20 - 30 K
	4 = >30 K
M. Art.	1 = 0 - 5 K
	2 = 5 - 10 K
	3 = 10 - 15 K
	4 = > 15 K

FIGURE B-1

Control Card Variable Values For

Program ECOMP

emissions are desired. The logic then provides for reading in a line source record and, for each hour, computing emissions of HC, NO_x, CO, SO_2, and particulates for light duty vehicles, light duty trucks, heavy duty gasoline vehicles, and heavy duty diesel vehicles. If the grid total option is set, these emissions are then added to the total for the appropriate grid. The program then returns to finish the remaining hours for line source at hand or if all the hours are completed then it returns to read another line source record. The operation is detailed in the flowchart figure B-2.

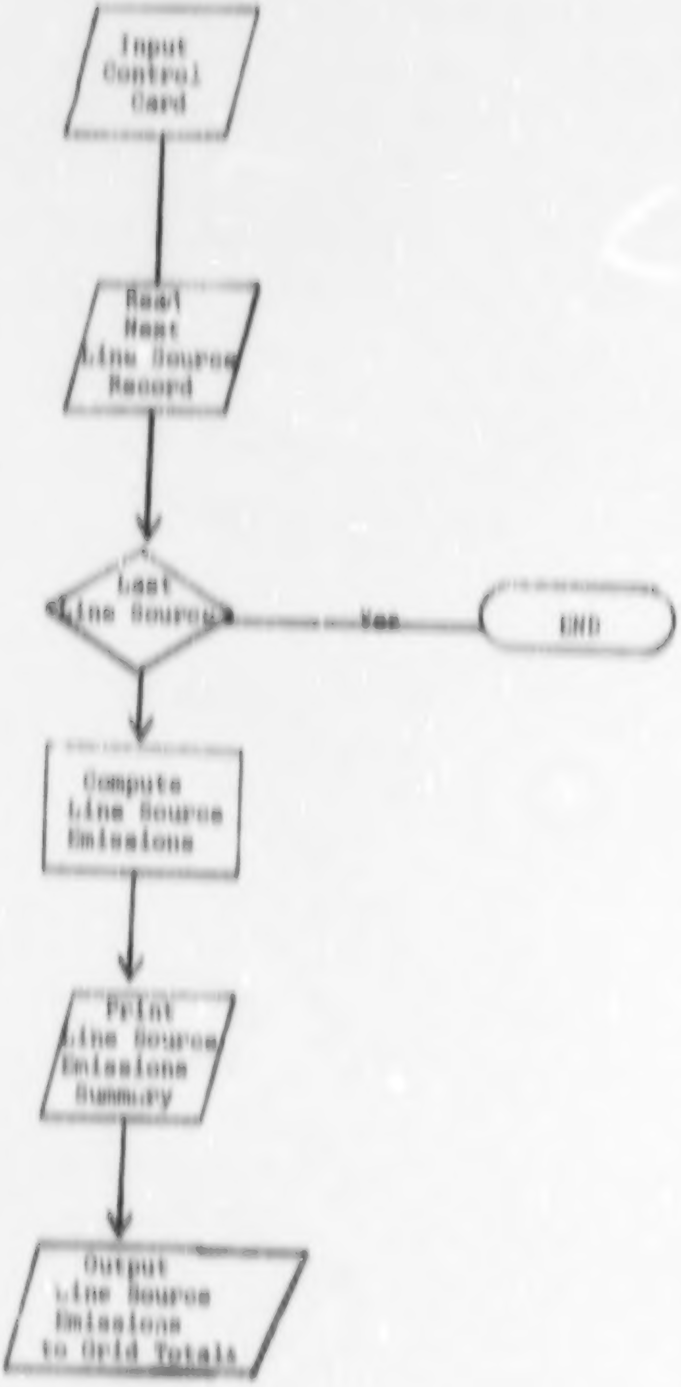

Input
Control
Card
Read
Next
Line Source
Record
Last
Line Source
Yes
END
Compute
Line Source
Emissions
Print
Line Source
Emissions
Summary
Output
Line Source
Emissions
to Grid Totals

FIGURE B-2

ECOMP PROGRAM

FLOWCHART

```
      REAL*8 NERATE,NO,CO,HC,TSO2,TPART
      DEFINE FILE 8(2500,56,E,IOU)
C*****************************************************************************
      DIMENSION EPTNCP(48),EPTCOP(48),EMTHCP(48),EMTCO(48),EPTNC(48),
C
     1EMTHC(48),IHRS(24),FREIST(24),IEMTCP(6,4,1),IEMTPK(6,4,3)
C
C*****************************************************************************
C
      DATA IHRS/1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,
     *21,22,23,24/
C
C
      DATA IEMTCP/1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,
     121,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,
     242,43,44,45,46,47,48/
C
C*****************************************************************************
C
      DATA IEMTPK/1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,
     121,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,
     242,43,44,45,46,47,48/
C*****************************************************************************
C
C                       NOX PEAK HOUR EMISSION RATES
C                          (GRAMS/KILOMETER CORRECTED)
C          ( 75 DEGREES F AMBIENT TEMP., 10 PCT COLD OPERATION)
C
C*****************************************************************************
C
      DATA EPTNCP/9.46,10.56,0.0,0.0,0.0,17.29,9.03,0.0,0.0,12.19,
C
     18.27,16.77,0.0,26.88,7.95,23.41,10.52,4.74,0.0,0.0,0.0,2.86,
C
     27.32,4.40,0.0,0.0,3.08,20.66,0.0,0.0,0.0,14.10,25.22,26.33,0.0,
C
     30.0,6.48,15.21,33.42,4.53,0.0,10.10,8.55,4.01,0.0,0.0,5.20,16.67/
C
C*****************************************************************************
C
C                       NOX OFF-PEAK HOUR EMISSION RATES
C                          (GRAMS/KILOMETER CORRECTED)
C          ( 75 DEGREES F AMBIENT TEMP., 10 PCT COLD OPERATION)
C
C*****************************************************************************
C
      DATA EPTNC/8.38,11.94,0.0,0.0,0.0,20.22,9.57,0.0,0.0,20.38,9.53,
C
     116.74,0.0,23.56,8.38,18.5,11.7,10.94,0.0,0.0,0.0,5.32,10.64,3.59,
C
     20.0,0.0,3.45,7.78,0.0,0.0,0.0,0.0,4.61,24.29,22.99,0.0,0.0,5.14,31.19,
C
     132.33,5.08,0.0,6.13,12.66,6.18,0.0,0.0,7.67,5.26/
C
C*****************************************************************************
C
C                       CO PEAK HOUR EMISSION RATES
C                          (GRAMS/KILOMETER CORRECTED)
C          ( 75 DEGREES F AMBIENT TEMP., 10 PCT COLD OPERATION)
```

```
C
C*******************************************************************************
C
      DATA EMTCOP/69.18,72.12,0.0,0.0,0.0,160.73,70.66,0.0,0.0,84.33,
     143.07,146.27,0.0,265.98,47.57,203.89,57.85,40.51,0.0,0.0,0.0,
C
     214.35,84.44,18.79,0.0,0.0,65.47,131.42,0.0,0.0,0.0,88.14,205.68,
C
     3240.82,0.0,0.0,39.46,76.86,255.64,26.93,0.0,83.47,65.55,38.63,
C
     40.0,0.0,29.76,107.61/
C
C*******************************************************************************
C
C                     CO OFF-PEAK HOUR EMISSION RATES
C                        (GRAMS/KILOMETER CORRECTED)
C           ( 75 DEGREES F AMBIENT TEMP.; 10 PCT COLD OPERATION)
C
C*******************************************************************************
C
      DATA EMTCC/52.09,97.74,0.0,0.0,0.0,215.25,66.31,0.0,0.0,187.71,
C
     169.17,108.88,0.0,205.35,51.73,136.13,67.24,59.94,0.0,0.0,0.0,
C
     253.10,95.09,24.48,0.0,0.0,26.79,40.58,0.0,0.0,0.0,83.32,196.85,
C
     3187.67,0.0,0.0,25.81,240.17,248.65,25.57,0.0,44.13,60.28,36.97,
C
     40.0,0.0,42.92,27.16/
C
C*******************************************************************************
C
C                     HC  PEAK HOUR EMISSION RATES
C                        (GRAMS/KILOMETER CORRECTED)
C           ( 75 DEGREES F AMBIENT TEMP.; 10 PCT COLD OPERATION)
C
C*******************************************************************************
C
      DATA EMTHCP/3.61,4.06,0.0,0.0,0.0,7.68,3.62,0.0,0.0,5.29,2.89,
C
     17.23,0.0,12.42,2.93,10.34,4.14,2.41,0.0,0.0,0.0,1.02,4.72,2.37,
C
     20.0,0.0,2.65,8.51,0.0,0.0,0.0,5.81,11.66,11.80,0.0,0.0,2.48,
C
     35.61,14.43,1.91,0.0,5.20,4.15,2.40,0.0,0.0,2.10,7.02/
C
C*******************************************************************************
C
C                     HC  OFF-PEAK HOUR EMISSION RATES
C                        (GRAMS/KILOMETER CORRECTED)
C           ( 75 DEGREES F AMBIENT TEMP.; 10 PCT COLD OPERATION)
C
C*******************************************************************************
C*******************************************************************************
C
      DATA EMTHC/3.08,4.84,0.0,0.0,0.0,5.35,3.75,0.0,0.0,5.07,3.80,6.06,
C
     10.0,10.47,3.09,7.81,4.68,4.24,0.0,0.0,0.0,3.09,5.64,1.85,0.0,0.0,
C
     21.76,2.97,0.0,0.0,0.0,4.57,10.66,10.02,0.0,0.0,1.52,13.58,14.05,
C
     12.19,0.0,2.89,4.91,2.62,0.0,0.0,1.12,2.05/
C
      DATA HRDIST/1.76,1.18,.55,.30,.24,.67,2.81,5.91,5.73,4.44,4.66,
     *5.14,5.64,5.34,5.59,6.72,7.92,7.45,6.90,6.20,5.12,4.38,3.25,2.36/
C
C*******************************************************************
C*******************************************************************
C****************************VARIABLES******************************
C*******************************************************************
C*******************************************************************
C
C     IVCR= VOLUME/CAPACITY RANGE SELECTED
C
C     IADTR= AVERAGE DAILY TRAFFIC RANGE SELECTED
C
C      IFCL= FUNCTIONAL CLASS OF ROADWAY
C
C     NOHR NUMBER OF HOURS TO BE COMPUTED
C
C     TPCT= TRUCK PERCENTAGE
C
C     IOUT=1 IF EMISSIONS ARE TO BE ADDED TO GRID TOTALS
C
C*******************************************************************
C*******************************************************************
C*******************************************************************
C
C
      THC=0.
      TCO=0.
      TNO=0.
      TTSO2=0.
      TTPART=0.
      TVMT=0.
      SHC=0.
      SCO=0.
      SNO=0.
      SSO2=0.
      SPART=0.
      SVMT=0.
      READ (5,10) IVCR,IADTR,IFCL,NOHR,TPCT,IOUT,IOUTA,ICLTB
      IF (NOHR.EQ.24) GO TO 21
C
      READ (5,20) (IHRS(I),I=1,NOHR)
C
C
   10 FORMAT (6I2,F2.2,3I1)
C
   20 FORMAT (24I2)
C
   21 WRITE (6,39)
C
C*******************************************************************
C
   39 FORMAT ('1',30X,'UTM COORDINATES',39X,'POLLUTANTS (KILOGRAMS)')
C
```

```
      WRITE (6,40)
C
C******************************************************************************
C
   40 FORMAT ('1','HOUR',1X,'LINK',1X,'GRID',1X,'STATE',1X,'CNTY',3X,
C
     1'A NODE',7X,'B NODE',6X,'ADT',2X,'HRLY VOL',1X,'F CLASS',
C
     21X,'DIST',6X,'HC',6X,'CO',6X,'NO',5X,'SO2',4X,'PART.')
C
C******************************************************************************
C******************************************************************************
C
   25 READ (5,30,END=999) UTMAX,UTMAY,UTMBX,UTMBY,ISTATE,ICNTY,IGRID,
     1ILNK,DIST,IVEL,IFCL
C
C******************************************************************************
C******************************************************************************
C
   30 FORMAT (12X,4F5.1,I1,I2,I5,60X,I6,F4.2,I6,72X,I1)
C
C
      DO 100 I=1,NCHR
C
      IF (IVEL.EQ.0) GO TO 200
C******************************************************************************
C
C      CHECKING TO SEE IF THE HOUR IS A PEAK HOUR
C
C******************************************************************************
C******************************************************************************
C
      IF (IHRS(I).EQ.8) GO TO 55
C
      IF (IHRS(I).EQ.9) GO TO 55
C
      IF (IHRS(I).EQ.17) GO TO 55
C
      IF (IHRS(I).EQ.18) GO TO 55
C
      IF (IHRS(I).EQ.13) GO TO 55
C
C******************************************************************************
C******************************************************************************
C
      IEMIT=IEMTOP(IAUTR,IVCR,IFCL)
      IPK=0
      GO TO 65
C
C******************************************************************************
C
   55 IEMIT=IEMTPK(IAUTR,IVCR,IFCL)
      IPK=1
   65 CONTINUE
C
C******************************************************************************
C
C      HRDIST(I) = PERCENT OF ADT OCCURING IN THE ITH HOUR
C
```

```
C*************************************************************************
C
      HRPCT=HRDIST(I)
C
C*************************************************************************
C
C     IHRVOL= VOLUME IN THE HOUR UNDER CONSIDERATION
      IHRVOL=IVOL*HRPCT*.01
      VMT=IHRVOL*DIST
      TVMT=TVMT+VMT
C
C*************************************************************************
C
C     ITVOL= TOTAL TRUCK VOLUME
C
C*************************************************************************
C
      ITVOL=TPCT*IHRVOL
C
C     LDTV= LIGHT DUTY TRUCK VOLUME
      LDTV=0.5*ITVOL
C
C     IHDDV= HEAVY DUTY DIESAL VOLUME
C
      IHDDV=0.4*ITVOL
C
C     IHDGV= HEAVY DUTY GASOLINE VOLUME
      IHDGV=0.1*ITVOL
C
C     LDV= AUTO VOLUME
C
      LDV=IHRVOL-ITVOL
      IF (IPK.EQ.0) GO TO 95
C
      CORATE=EMTCOP(IEMIT)
C
      NORATE= EMTNOP(IEMIT)
C
      HCRATE=EMTHCP(IEMIT)
C
      GO TO 105
C*************************************************************************
   95 CORATE=EMTCO(IEMIT)
C
      NORATE=EMTNO(IEMIT)
C
      HCRATE=EMTHC(IEMIT)
C
  105 CONTINUE
C*************************************************************************
C
C*************************************************************************
C     LIGHT DUTY TRUCK, HEAVY DUTY DIESAL AND GAS EMISSION RATES FROM
C    AP-42 SUP. 5 ASSUMING 75 DEG. F AMBIENT TEMP AND 30 MPH AVG. SPEED
C*************************************************************************
C*************************************************************************
      CO=CORATE*LDV*DIST
C
      NO=NORATE*LDV*DIST
```

```
C
      HC=HCRATE*LEV*DIST
C
      CO=CO+(27.54*LETV*DIST)
C
      NO=NO+(1.24*LETV*DIST)
C
      HC=HC+(1.22*LDTV*DIST)
C
      CO=CO+(49.8*IHDGV*DIST)
C
      NO=NO+(13.*IHDGV*DIST)
C
      HC=HC+(6.79*IHDGV*DIST)
C
      CO=CO+(9.54*IHDDV*DIST)
C
      NO=NO+(15.63*IHDDV*DIST)
C
      HC=HC+(2.06*IHDDV*DIST)
C
      SO2LDV=(.08*LDV*DIST)
C
      PARTLV=(.33*LDV*DIST)
C
      SO2LDT=(.11*LDTV*DIST)
C
      PARTLT=(.33*LDTV*DIST)
C
      SO2HDG=(.22*IHDGV*DIST)
C
      PARHDG=(.68*IHDGV*DIST)
C
      SO2HDD=(IHDDV*DIST*1.7)
C
      PARHDD=(IHDDV*DIST*.93)
C
      TSO2=(SO2LDV+SO2LDT+SO2HDG+SO2HDD)/1000.0
C
      TPART=(PARTLV+PARTLT+PARHDG+PARHDD)/1000.0
C
C
      CO=CO/1000.0
      NO=NO/1000.0
      HC=HC/1000.0
      THC=THC+HC
      TCO=TCO+CO
      TNO=TNO+NO
      TTSO2=TTSO2+TSO2
      TTPART=TTPART+TPART
      IHR=IHRS(II)-1
      GO TO 115
  200 IHRVOL=0
      HC=0.
      CO=0.
      NO=0.
      TSO2=0.
      TPART=0.
      IHR=IHRS(II)-1
```

```
 115 IF (ICUTB.NE.1) GO TO 116
      WRITE (6,50) IHR,ILAK,IGRID,ISTATE,ICNTY,LTMAV,LTMAX,LTPRY,LTPRX,
C
     1IVEL,IHRVEL,IFCL,DIST,HC,CO,NO,TSO2,TPART
C
  50 FORMAT (' ',1X,I2,2X,I4,1X,I4,1X,I1,4X,I2,1X,F6.1,1X,F5.1,1X,
C
     1F6.1,1X,F5.1,1X,I6,2X,I4,7X,I1,1X,F5.2,1X,F6.3,1X,F7.3,1X,F6.3,
C
     21X,F6.3,1X,F6.3)
 116 IF (IHR.LT.23) GO TO 125
      IHRVEL=0
      WRITE (6,110)    ILAK,IGRID,ISTATE,ICNTY,LTMAV,LTMAX,LTPRY,LTPRX,
     1IVEL,IHRVEL,IFCL,DIST,THC,TCO,TNO,TTSO2,TTPART
 110 FORMAT (' ','ALL',2X,I4,1X,I4,3X,I1,4X,I2,1X,F6.1,1X,F5.1,1X,
     1F6.1,1X,F5.1,1X,I6,2X,I4,7X,I1,3X,F5.2,1X,F8.2,1X,F9.2,1X,F8.2,
     *1X,F8.2,1X,F8.2)
 125 IF (ICUTA.NE.1) GO TO 135
      IDIST=DIST*100.
      ICO=CO*1000.0
      INO=NO*1000.0
      IHC=HC*1000.0
      ITSO2=TSO2*1000.0
      ITPART=TPART*1000.0
      IUTMAX=UTMAX*10.
      IUTMAV=UTMAV*10.
      IUTPRX=UTPRX*10.
      IUTPRY=UTPRY*10.
      WRITE (10,90) IHR,ILAK,IGRID,ISTATE,ICNTY,ILTMAV,ILTMAX,ILTPRY,
     *IUTPRX,
     1IVEL,IHRVEL,IFCL,DIST,HC,CO,NO,TSO2,TPART
  90 FORMAT (I2,2I4,I1,I2,2(I6,I5),I6,I4,I1,I4,I6,I7,3I6)
 135 IF (ICUT.NE.1) GO TO 100
      IF (IGRID.GT.2503) GO TO 100
      IREC=IGRID
C***********************************************************************
      FIND (8'IREC)
      ICO=CO*1000.0
      INO=NO*1000.0
      IHC=HC*1000.0
      ITSO2=TSO2*1000.0
      ITPART=TPART*1000.0
C***********************************************************************
C
      READ (8'IREC,60) IGRID,IVKT,JTCO,JTNO,JTHC,JTSO2,JTPART
C
  60 FORMAT (I6,6I7)
C***********************************************************************
C***********************************************************************
      IVKT=IVOL*DIST
      JTNO=JTNO+INO
      JTCO=JTCO+ICO
      JTHC=JTHC+IHC
      JTSO2=JTSO2+ITSO2
      JTPART=JTPART+ITPART
C***********************************************************************
C***********************************************************************
      WRITE (8'IREC,60) IGRID,IVKT,JTCO,JTNO,JTHC,JTSO2,JTPART
C***********************************************************************
```

```
************************************************************************
 100 CONTINUE
     SHC=SHC+THC
     SCO=SCO+TCO
     SNO=SNO+TNO
     SSO2=SSO2+TTSO2
     SPART=SPART+TTPART
     SVKT=SVKT+TVKT
     THC=0.
     TCO=0.
     TNO=0.
     TTSO2=0.
     TTPART=0.
     TVKT=0.
     GO TO 25
************************************************************************
 999 REWIND 4
     WRITE (6,70)
  70 FORMAT (' ','POLLUTANT TOTALS IN KILOGRAMS')
     WRITE (6,80) SHC,SCO,SNO
  80 FORMAT (' ','TOTAL HC=',F8.2,4X,'TOTAL CO=',F10.2,4X,
    *'TOTAL NO=',F8.2)
     WRITE (6,81) SSO2,SPART,SVKT
  81 FORMAT (' ','TOTAL SO2=',F8.2,4X,'TOTAL PARTICULATES=',F8.2,4X,
    *'TOTAL VKT=',F12.2)
************************************************************************
     STOP
************************************************************************
     END
```

APPENDIX C. ASEP: COMPUTER PROGRAM DOCUMENTATION

Program Documentation for Program ASEP (Area Source Emissions Program)

A. Purpose - This program is designed to compute estimates of emissions from the mobile source component of non-line/area sources. The program estimates emissions for any set of EPA grid squares for any set of hours of the day.

B. Inputs

1. The first set of inputs to the program is a pair of control cards, the first specifying the number of hours for which emissions are desired, whether or not hourly emissions are to be printed, and if emissions are to be written onto disk or tape for later use. The second control card specifies the particular hours desired. Note that if all 24 hours are desired, the user may simply code 24 as the number of hours on the first control card and not code the second control card.

2. The second set of inputs are the VKTs for principal arterials and minor arterials in each EPA grid square. The program uses these to compute the VKT for local and collector streets. These inputs are usually on tape or disk. Both of the control cards are read off units number 5.

C. Operation

The program proceeds by reading in the control cards specifying the number of hours for which emissions are desired and whether or not hourly totals are to be printed for each grid. If the number of hours specified is 24, then the next control card is skipped. If 24 hours are not specified the program reads in from the next control card the hours desired in I2 format. The program then reads in a record containing a grid number and principal and minor arterial VKTs. It then computes the local and collector VKT with a factor determined from a sample of St. Louis data which is discussed in Chapter IV of this report. The program then computes emissions of HC, CO, NO, SO_2, and particulates using emission factors from AP-42 Supplement 5 for calendar year 1975 assuming 19 miles per hour average speed, 75°F ambient temperature, and 20% cold operation. Following the computations, the program optionally prints an hourly summary, then a daily summary for each grid. At the same time the program optionally will write the same information on tape or disk. Finally, the program prints pollutant totals for all hours computed for all grids. A slight coding change to a DO statement allows the program to compute grid area source emissions for any grid or grids in the AQCR.

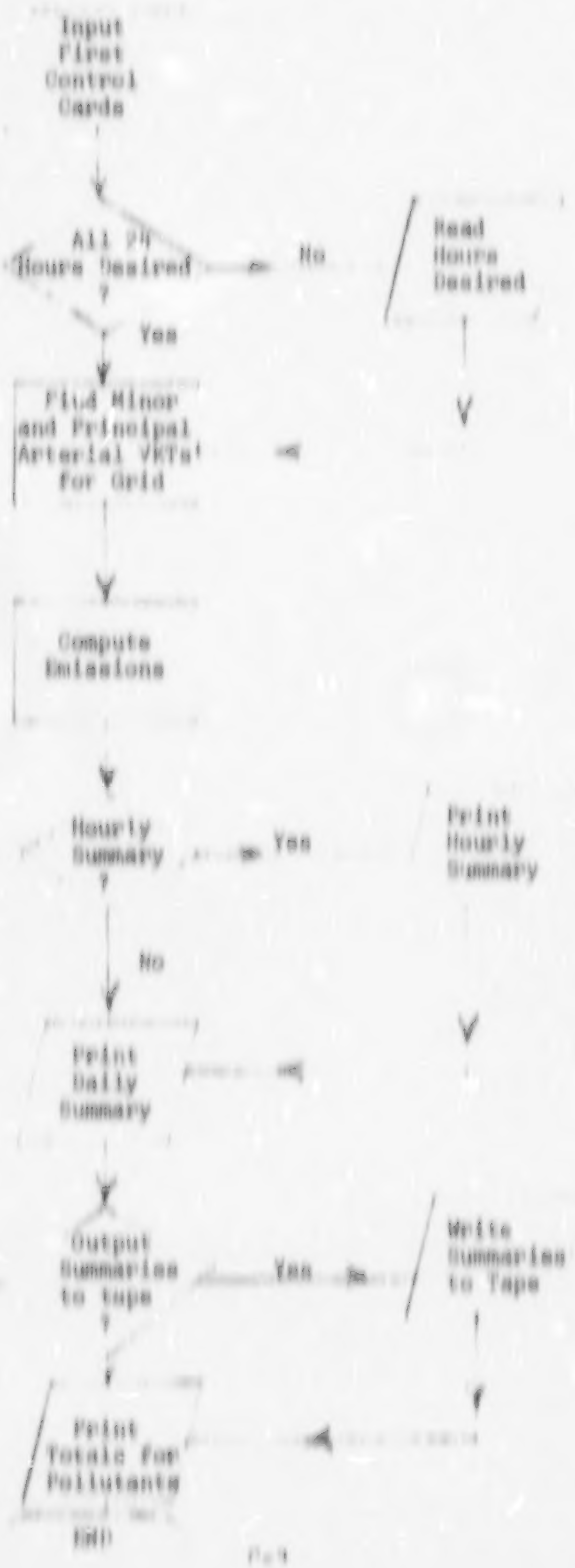
D. Outputs

1. Printer hourly summary with grid numbers, hour, VKT, and totals for each pollutant is available; printer daily summary for each grid is default (Unit number 6).
2. Hourly and daily summaries identical to (1) above are also available output to tape or disk (Unit number 12).

E. Program flowchart—see Figure C-1.

FIGURE C-1

Flowchart for Program ASEP


Input
First
Control
Cards
All 24
Hours Desired
?
No
Read
Hours
Desired
Yes
Find Minor
and Principal
Arterial VKTs'
for Grid
Compute
Emissions
Hourly
Summary
?
Yes
Print
Hourly
Summary
No
Print
Daily
Summary
Output
Summaries
to tape
?
Yes
Write
Summaries
to Tape
Print
Totals for
Pollutants
END

```
      DIMENSION HRPCT(24),IHRS(24)
      REAL*4 NO,MAVKT
      DATA IHRS/1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,
     *21,22,23,24/
      DATA HRPCT/1.76,1.10,.55,.30,.24,.47,2.81,5.91,5.33,4.44,4.66,
     *5.14,5.64,5.34,5.59,6.72,7.92,7.95,6.90,6.20,5.12,4.38,3.29,2.36/
      READ (5,10) NOHR,IPRT,IPRTA
10    FORMAT (I2,2I1)
      IF (NOHR.EQ.24) GO TO 15
      READ (5,20) (IHRS(I),I=1,NOHR)
20    FORMAT (24I2)
15    L=24
      VKTA=0.
      TVKT=0.
      TCO=0.
      TNO=0.
      THC=0.
      TSO2=0.
      TPART=0.
      IGRID=0
      VKT=0.
      SVKT=0.
      SHC=0.
      SCO=0.
      SNO=0.
      SSO2=0.
      SPART=0.
      WRITE (6,40)
40    FORMAT (' ',37X,'POLLUTANT TOTALS - IN KILOGRAMS')
      WRITE (6,50)
50    FORMAT (' ','GRID',1X,'HOUR',5X,'VKT',5X,'HC',9X,'CO',9X,'NO',
     *8X,'SO2',5X,'PARTICULATES')
      DO 100 I=1,2500
      IF (IGRID.EQ.I) GO TO 35
      IF (IGRID.GT.I) GO TO 100
25    READ (4,60,END=99) IGRID,PAVKT,MAVKT
60    FORMAT (I6,10X,2F10.2,44X)
      IF (IGRID.GT.I) GO TO 100
35    VKTA=PAVKT+MAVKT
      IF (VKTA.EQ.0.) GO TO 91
      DO 90 J=1,NOHR
      JHR=IHRS(J)
      P=HRPCT(JHR)*.01
      VKT=.1856*VKTA
      VKTHR=P*VKT
      HC=(VKT*2.618*P)/1000.
      CO=(VKT*38.716*P)/1000.
      NO=(VKT*.874*P)/1000.
      SO2=(VKT*.08*P)/1000.
      PART=(VKT*.33*P)/1000.
      THC=THC+HC
      TCO=TCO+CO
      TNO=TNO+NO
      TSO2=TSO2+SO2
      TPART=TPART+PART
      TVKT=TVKT+VKTHR
      IF (IPRT.NE.1) GO TO 90
      JHR=JHR-1
      WRITE (6,80) I,JHR,VKTHR,HC,CO,NO,SO2,PART
      IF (IPRTA.NE.1) GO TO 90
      IVKTHR=VKTHR*100.
      IHC=HC*1000.
      ICO=CO*1000.
      INO=NO*1000.
      ISO2=SO2*1000.
      IPART=PART*1000.
      WRITE (6,70) I,JHR,IVKTHR,IHC,ICO,INO,ISO2,IPART
   70 FORMAT (I4,I2,I10,5I9)
   90 CONTINUE
   91 IF(IPRTA.NE.1) GO TO 92
      ITVKT=TVKT*100.
      ITHC=THC*1000.
      ITCO=TCO*1000.
      ITNO=TNO*1000.
      ITSO2=TSO2*1000.
      ITPART=TPART*1000.
      WRITE (6,70) I,L,ITVKT,ITHC,ITCO,ITNO,ITSO2,ITPART
   92 WRITE (6,30) I,L,TVKT,THC,TCO,TNO,TSO2,TPART
   30 FORMAT (' ',I4,2X,I2,2X,F10.2,2X,5(F9.3,2X))
      SVKT=SVKT+TVKT
      SHC=SHC+THC
      SCO=SCO+TCO
      SNO=SNO+TNO
      SSO2=SSO2+TSO2
      SPART=SPART+TPART
      THC=0.
      TCO=0.
      TNO=0.
      TSO2=0.
      TPART=0.
      TVKT=0.
  100 CONTINUE
   99 REWIND 4
      WRITE (6,79)
   79 FORMAT ('1','RAPS-ST. LOUIS AQCR GRID TOTALS- IN KILOGRAMS')
      WRITE (6,80) SVKT,SHC,SCO,SNO
   80 FORMAT (' ','TOTAL VKT=',F13.3,3X,'TOTAL HC=',F10.3,3X,
     *'TOTAL CO=',F13.3,3X,'TOTAL NO=',F10.3)
      WRITE (6,81) SSO2,SPART
   81 FORMAT (' ','TOTAL SO2=',F10.3,3X,'TOTAL PARTICULATES=',F10.3)
      STOP
      END
```

END

DATE

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10-19-77

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